THE

ELECTRICAL REVIEW.

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THE

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THE LATEST ELECTRICAL MARVELS.

IN the daily newspapers during the past week we have noticed several references to some electrical demonstrations at Hughenden, which have been described as the latest electrical marvels. These papers have generally contented themselves with recording what they saw or heard, but a correspondent of the *Spectator*, who signs himself "X.," gives us an opportunity of learning something of the principles governing these latest marvels. "Having been present," he says, "at the experiments conducted by Messrs. Armstrong and Orling in the transmission of electrical energy without wires, I shall attempt, with your leave, to present a few reflections on them. The results of the experiments you already know, and I shall not offer you an unnecessary catalogue of them." "X.'s" reflections, like X rays, reveal much that was hitherto hidden. The results being already "known," and the "catalogue" of experiments "unnecessary," we are able to give our undivided attention to the "reflections." We gather that "whereas the Marconi system works through the air, the 'Armorl' system, as it is called, sends its radiations most frequently through the ground or through the water." It is to be regretted that we are not informed as to the medium selected on those infrequent occasions when land or water are despised. But this is not strictly material. As "X." understands it, the "Armorl" system professes to have two advantages over the Marconi system; it is better for land use, and it provides for a secrecy as yet not secured in practice by Marconi messages, "open as they are to all the world and his receiver." The reasons for these advantages are perfectly obvious to "X." The Marconi rays which pass intact over the sea seem to lose a great percentage of their strength when travelling over woods and towns. You might suppose, says "X.," that the (Armorl) electrical radiations, when once they had come in contact with the earth, would disperse in all directions, and be lost for all practical purposes. "Nothing of the sort appears to happen." In fact, the inventor believes that "they arrive at their destination as strong as when they started; if they lose something, they also gain something, being reinforced in some way, as yet insufficiently explained, from the natural electricity of the earth." We do not understand why the explanation should be insufficient, but we are bound to take "X.'s" word for it, since, from the absence of any explanation at all, we are unable to judge of its sufficiency or otherwise.

Nor is there any special need. "Be the explanation what it may," says "X.," "the fact is that the 'Armorl' system is now achieving, with low voltages, results formerly attained by M. Tesla only with extremely high voltages." After all, the essential thing is the fact, and the explanation may very well wait. There is much in the letter thus far that needs some technical knowledge for its due appreciation. There has been lacking that application of analogy which helps to make mysteries understanded of the multitude.

But the analogy is forthcoming. "If Mr. Armstrong may be believed, an 'Armorl' message, in the freedom of its passage, is to an overland Marconi message as a train in the 'Twopenny Tube' is to an omnibus working its way along Oxford Street on a crowded day." There are limitations to the permissible use of the subjunctive, and although it is true an editor disclaims responsibility for the opinions of his correspondents, it surprises us that so responsible and so venerable a paper as the *Spectator* should permit the use of such a phrase: "*If* Mr. Armstrong may be believed," seems to us language which Mr. Armstrong may be justified in resenting.

The true inwardness of the Armorl system is sympathetic vibration. "You know the way in which, when you make a particular sound in a room, a sympathetic ring sometimes comes from a glass globe. Well, the equivalent of this sympathy in the pitch or tone of sounds exists among electrical radiations. There are 40,000 of these electrical pitches or tones. Mr. Orling, excellent master of the electrical circus ring, provides that all the tones shall move in their proper places without getting in one another's way." Not content with inferentially suggesting doubts of Mr. Armstrong's veracity, "X" has the audacity to describe his partner, Mr. Orling, as an "excellent master of the electrical circus ring." Mr. Orling, as a serious investigator of natural laws and intent upon their practical application, seems to us to have an equal right with Mr. Armstrong to resent "X.'s" language. Any man who has taken a census of electrical harmonic vibrations and recorded them to the odd or even thousand, should not be described as the master of a circus ring. The record alone is an achievement, but when the same master provides that the tones shall move in their proper places without getting in one another's way, a result is attained which is so practically advantageous as to be entitled to more dignified analogy.

The advantage of the discovery is obvious to "X." He does not pretend that the Armstrong-Orling inventions are yet in a practical working state. He is no enthusiast about "fledgling" discoveries. He knows their high rate of mortality. But no man who heard, as he did, the articulate human voice rise through a long spike, devoid of wires, which had been thrust into the ground, can doubt that here we have the beginnings of an important change. He thinks that "Some day men and women will carry a wireless telephone as commonly as to-day we carry a card case or a camera. We shall switch ourselves on to the underground radiations through the medium of our walking sticks or our boots. We shall then tune up our receiver to tone number 39,451, or whatever may be the lawfully registered wireless telephone number of him to whom we would speak." We trust that the inventors will contrive so that it may not be essential for both men and women to carry walking sticks. We have a preference for the boot method. For the present, at any rate, boots are common to both sexes. Boots have the additional advantage in this climate of being better electrical conductors than walking sticks for at least a large portion of the year. "X." should have stated, however, that "rubbers" or "goloshes" must be abandoned by the wireless telephonist that is to be. After all, there is nothing like leather.

Whilst "X." recognises that the telephonic side of the invention may be the most remarkable, the wireless control of moving bodies is likely to be the more immediately useful "to the nation." "But it must not be thought that the control of a torpedo in this way is a new thing." "X." cites previous instances, and actually says that "there must be other cases outside my knowledge," which is evidence enough that "X." is one of those broad-minded individuals who do not claim to know everything. Under these circumstances, we have less hesitation in asking if "X." ever heard of previous instances of telephoning without wires? But after all, what are those simple "anticipations" of the latest marvels? They must not for one moment be allowed to detract from the importance of the work of Messrs. Armstrong and Orling.

We owe some apologies to our readers for not being able to put before them details of this important work. Anxious as we are to record "latest marvels," we are unable to do so in this instance. We hasten to say that the fault is not ours. We have not had the opportunity. It was to Hughenden that Lord Beaconsfield retired to cultivate primroses. It was to Hughenden that "X." and press representatives repaired to "hear the articulate human voice rise through a long spike." We trust that the interests of the electrical profession may yet be considered of sufficient importance to submit these unparalleled discoveries to our investigation. We should be glad of an opportunity of visiting a town hallowed with memories of the past and destined to be the birthplace of inventions fraught with such importance—in the future. We should especially like to see the performances in those electrical Circus rings. Who is there with soul so dead as not to derive enjoyment from a circus? What youthful memories are awakened by the name! Yet look down the not "unnecessary catalogue" in memory's list. Recall the *personnel*. Who is the immortal? The ring-master was gorgeous and imposing. Perhaps he was skilful, but we knew it not. His impression has faded. All that is indelible is the clown!

Wireless Telegraphy.

WIRELESS telegraphy has evidently not yet reached finality. We read recently in the daily press that Marconi had succeeded in sending messages over a distance of 350 miles. We understand that this is a fact, and, moreover, that it by no means represents the limit attainable by Marconi with his latest apparatus, since he has offered to give a demonstration to the Admiralty of wireless telegraphy over a distance of 500 miles. At this rate of progress wireless telegraphy will soon become a dangerous rival to submarine cables. If, however, wireless telegraphy should become at all common, the difficulty of sending non-interfering messages will become increasingly great. The syntonic apparatus devised by Marconi may work perfectly if not interfered with, but there is no safeguard against the messages being tapped by means of a receiver of adjustable pitch. When the syntonic system is used for naval or military purposes, the danger is that electric disturbances of varying pitch will be created by the enemy so as to render all wireless telegraphy impossible. The possibility and a means of upsetting the enemies' telegrams has been pointed out to us by a correspondent from South Africa; but he has been anticipated in his idea by the experimenters at the United States Weather Bureau (ELECTRICAL REVIEW, Vol. 49, p. 174). It is a remarkable fact that the range of wireless telegraphy at sea has always been much greater than in mountainous country. This is illustrated by the unsuccessful attempts which were made last year to establish a connection by wireless telegraphy between the Meteorological Observatory on the Zugspitze, the highest summit in Germany, and the Postal Station at Eibsee, at its base, the difference in altitude between the two points being only 2,000 metres. The Allgemeine Elektricitäts Gesellschaft have, however, now succeeded in

overcoming the difficulties by an installation of the Slaby-Arco system. The failure of the Marconi system among the kopjes in South Africa was probably due to the same causes as those that have interfered with the success of installations in the Alpine regions of Europe, and not to the want of suitable long poles, as alleged by the Marconi Company. Blochmann attributes the obstruction of electric waves in hilly countries to the distortion of the equipotential surfaces of the earth's static charge by the uneven surface, and the explanation appears to be very plausible and to agree well with the facts.

Refuse Destruction.

We comment in another column upon Mr. Priestley's paper on "Refuse Destruction," read at the annual congress at the Royal Institute of Public Health. The results in point of evaporation of water are high, namely, about 1·85 lb. of water from and at 212° F. per pound of refuse. Such a result is all the more interesting as it is taken from figures, given by Mr. Priestley, of a test extending over a month, namely, from February 9th to March 16th of this year. It would appear that after deduction of the incombustible portion of the refuse, and after making reasonable allowance for moisture, the calorific value of the combustible portion of the refuse works out at something under one half that of average coal.

Standard Car Bodies.

The Car Committee of the American Street Railway Association recommends for single truck cars a body 20 ft. long. For city cars, bodies of 25 ft., measuring 35 ft. over-all and carried on two 4-wheel trucks, are recommended. For suburban service, car bodies are to be 30 ft. long; with car 40 ft. over-all. Open cars are recommended 30 ft. over-all, with 10 cross benches mounted on a single truck, and 12-bench cars 35 ft. over-all on four trucks. Oval roofs are preferred to the monitor roof, on the ground of first cost and also maintenance. No system of ventilation is yet recommended. The tendency of the practice is thus towards standardisation, and the experience of the Master Car Builders' Association may be cited as showing what may be hoped for if the same spirit actuates the street railway men. We cannot see why similar efforts should not be made here to secure some sort of standardisation. Half the work of a tramway engineer appears to consist in re-designing details that have been more or less thrashed out by a score of equally good and experienced men. This is sheer waste of energy, and the enormous number of different patterns of details must increase the cost of these to everyone. These subjects might very well be taken up by the Tramways Association, which includes amongst its members men who are connected with every variety of practice in cars, gauges, wheels, axles, &c.

Nernst Lamp.

Experiments with the Nernst lamp of commerce, described in the *Elektrotechnische Anzeiger* recently, show that there is a considerable falling off in light efficiency as the lamp gets older. This is quite in accordance with common experience of the Welsbach gas mantle, which is made of practically the same materials as the Nernst filament. The experiments described show that in one case where the lamp burnt 369 hours before it was destroyed, the efficiency at the commencement was 1·33 watts per candle; after 100 hours it fell to 1·91 watts per candle, then to 2·19 watts per candle at the end of 220 hours, to 2·68 watts per candle after 300 hours, and finally to 2·89 watts per candle after 350 hours. The experimenter considers that it is not advisable to burn the lamp without renewal more than 200 hours. Under these conditions the cost of the candle-hour, including the price of the lamp and depreciation, would be 0·035 as compared with 0·055 for a carbon incandescent lamp with an efficiency of 3·25 watts per candle. The American Nernst lamp which we described recently claims to have a considerably longer life than 200 hours, namely, about 700. The latter must be much superior in quality to the German lamp, or the limits of experimental error must be very wide in such tests.

REFUSE DESTRUCTION AT NELSON.

At the Annual Congress of the Royal Institute of Public Health, held this year at Eastbourne, an interesting paper on "Refuse Destruction" was read by Mr. Priestley, Assoc.San.Inst., the superintendent of the Health Department at Nelson, Lancashire.

The paper embodies the results of recent tests on a furnace of the Meldrum regenerative type, by which all the refuse of the town of Nelson is destroyed.

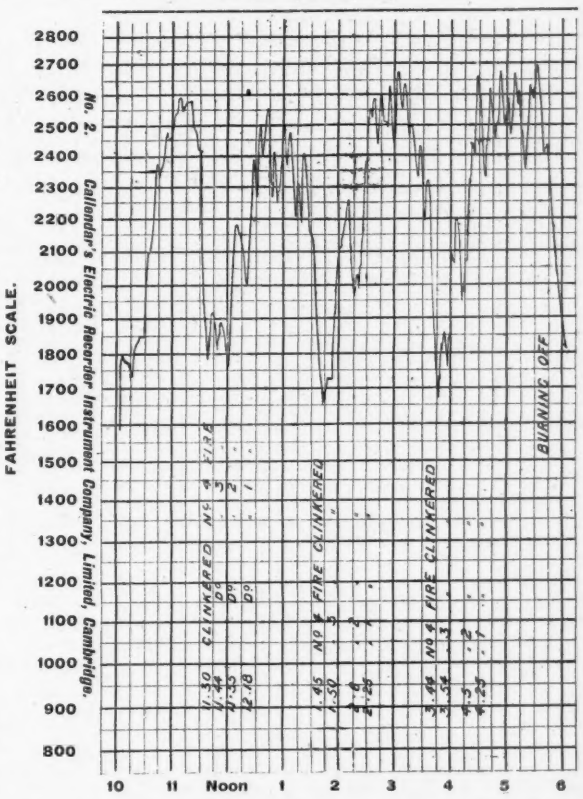
The destructor was only opened in December last, and consists of a furnace combustion chamber, Lancashire boiler and regenerator, the latter being an apparatus whereby the air supplied to the forced draught is heated to about 150° F.

The two chief features of interest in Mr. Priestley's paper are the detailed description of the means adopted for determining the temperature in the combustion chamber and the results of a test extending over one month.

The combustion chamber temperature was obtained by one of Callendar's recording pyrometers. The principle upon which this instrument is based is the variation in the electrical resistance of a coil of platinum wire with variations of temperature. In the instrument used the platinum coil was enclosed in a porcelain tube. In order, however, to further protect the instrument, which is an extremely delicate one, Mr. Priestley wrapped the porcelain tube in asbestos packing, and then placed it inside a piece of wrought-iron piping, which was fixed through the pyrometer opening in the combustion chamber. The test lasted about nine hours, but Mr. Priestley states that by the end of the test the iron piping was melted off, the asbestos destroyed, and the porcelain tube fused through, leaving the platinum wires exposed.

Nelson Destructor.—8 Hours' Test.

Diagram of Temperature in Combustion Chamber taken with Callendar's Electrical Recording Pyrometer.



This points to a very high temperature, and from the above diagram it will be seen that the temperature recorded by this instrument showed a maximum of 2,693° F. and a minimum of 1,666° F. The temperatures were recorded continuously by a suitable autographic mechanism connected with the pyrometer.

D

Some difficulty is of necessity experienced in calibrating such a pyrometer, but Mr. Priestley has been careful to check these records by the ordinary copper and nickel tests, and by means of explosive cartridges. He states that a piece of nickel was melted, indicating a temperature of 2,600° F., and he also states that copper was constantly melted, which would point to an average temperature of over 2,000° F.

It is very interesting to note that Mr. Priestley has carried out a test extending over one month, namely, from February 19th to March 16th, 1901. He brings out the average evaporation of water per pound of refuse from and at 212° F. to 1·85 lbs., and in one or two places throughout his paper he draws attention to the fact that this result is almost identical with that obtained during a short-hour test, from which he concludes that "The contention that evaporative results obtained on a short test are not trustworthy is thus effectually disposed of."

We cannot agree with this view, for reasons which we have on previous occasions set forth in considerable detail, but the evaporation of 1·85 lbs. water from and at 212° F. continuously for about a month, using town refuse as fuel, is interesting, and points to the fact that the word "refuse" as applied to the Nelson product is somewhat of a misnomer. Mr. Priestley gives the total percentage of incombustible residual at 38·6 per cent. The moisture in the refuse can hardly be put down at less than 20 per cent., which would mean that the evaporative power of the combustible in the Nelson dry refuse is about 3·6 lbs. of water from and at 212° F. There are not many land boilers which evaporate on the average more than 8 lbs. of water per pound of coal from and at 212° F.; therefore, a pound of Nelson refuse must have a calorific power of somewhere about one-half that of average coal. It would thus appear that as long as refuse is to be obtained in towns, or perhaps we should say at Nelson, in sufficient quantities, the exhaustion of our cheap supplies of fossil fuel need cause us no great concern.

We think it would have been valuable if Mr. Priestley had given us some closer idea of the composition of the refuse burnt during this test, and also the percentage of moisture. It must be remarked that the test was carried on during the winter months, when the value of refuse as fuel is generally high.

It is also a little unexpected that, after so apparently convincing a result, Mr. Priestley should content himself with stating that it is not his intention to attempt to deal with the question of what constitutes the most satisfactory method of utilising the steam produced at Nelson, *as that opens up a wide field of speculation.*

Surely, if towns' refuse can be relied upon to evaporate 1·85 lbs. of water per pound from and at 212° F., what possible speculation can there be as to a satisfactory method of utilising the steam produced? It may be, however, that the cost of obtaining this high evaporative efficiency is great. Upon this point Mr. Priestley does not go into detail, but the financial aspect of steam raised from refuse is the crux of the whole question, when it is sought to demonstrate the value of refuse as a fuel. It may be mentioned that in the month's test the amount of steam used in the forced blast was 15 per cent. of the steam produced; this, of course, would bring down the net steam available to 1·5 lbs. of water per pound of refuse, which, however, is still a very respectable performance indeed.

We are glad to note that Mr. Priestley lays stress upon the efficient destruction of the refuse before any question of raising steam for industrial purposes is considered, as this is a point which we have consistently advocated for years past.

The Meldrum Destructors at Nelson.

GLASGOW INTERNATIONAL EXHIBITION, 1901.

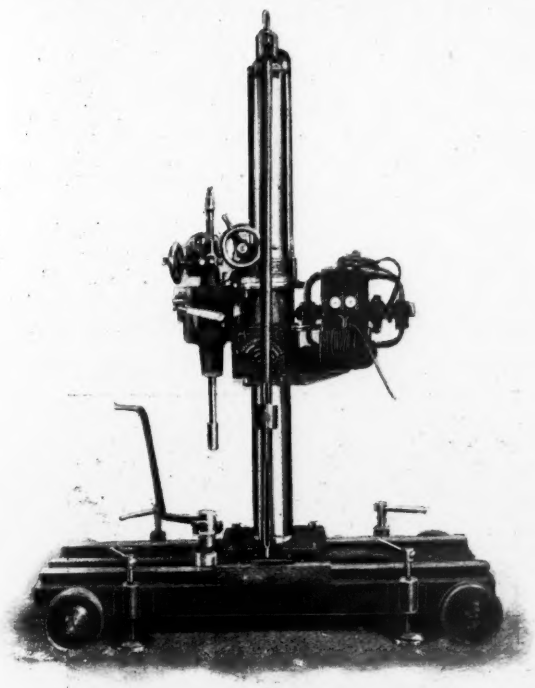
XV.

The British Schuckert Electric Company, Limited.

One of the most interesting exhibits is that of the British Schuckert Company in their Pavilion in "Machinery Street," this being in addition to their very fine show in the Machinery Hall. The Pavilion exhibit is mainly directed towards traction and mining purposes, and includes pumping, hauling, and rock-drilling machinery, as well as mining and other electric locomotives, and a large searchlight.

The principal feature of the exhibit is a double-acting duplex plunger pump, made by Messrs. Ehrhardt & Sehmer, of Schleifmühle, near Saarbrücken. The stroke of the plungers is 400 mm., and the capacity is 800 gallons per minute, against a head of 1,730 ft. This pump is driven direct by a direct-current motor, taking 970 amperes at 500 volts, and having a maximum output of 615 H.P. The

motor is mounted on a shaft centrally between the two cranks which work the pumps; it runs at 150 revolutions per minute, and generally resembles the large generator exhibited in the Machinery Hall, which we have already described. The chief point of difference is in the armature, which is of the smooth core type, instead of being slot wound; the conductors are driven by means of insulated driving strips, sunk into the core at frequent intervals, and extending the whole length of the armature. This type of winding, we understand, is regarded by Messrs. Schuckert as preferable to the toothed core construction. To prevent sparking, the pole tips are tapered off and skewed. The field magnet has 12 poles, shunt wound, with pole faces bolted on. The brush ring, which is usually supported from the bearing, is in this case carried by brackets from the yoke, as the bearing is too far off. The arrangement is extremely neat, the conductor rings being laid in a recess in the brush ring. The brush-holder spindles are cranked, and carbon brushes of the plunger type are used. The commutator is well ventilated, as well as the armature; screw fastenings are used for the commutator connections, which are very long. The bearings are lubricated by means of oil cups. Naturally the starter for such a machine, which must be able to start under load, presented a difficult problem. This was overcome by dividing the starter in two parts, coupled in parallel electrically and mechanically. The resistance coils are cooled in an oil bath, fitted with circulating water pipes. One of the most interesting features of the starter is the fact that after each step the brushes stand still on the contacts until the spark has been broken by a special "extinctor" outside the starter, so that there can never be any sparking on the contacts. A device of the "Geneva stop" type is used in connection with the gear.



Schuckert Pavilion: Portable Drill.

To load the motor, a fountain has been provided near the Pavilion in the form of a water-shell, which at the same time contains a basin 12 ft. in diameter. The water i taken from this basin and forced back again to i through circulating pipes from the pump, and finall through the fountain pipe. To effect a better play of the waterjet, a special jet spray apparatus is fitted in the basin, through which the water of the basin is forced up as wel as through the fountain mouthpiece.

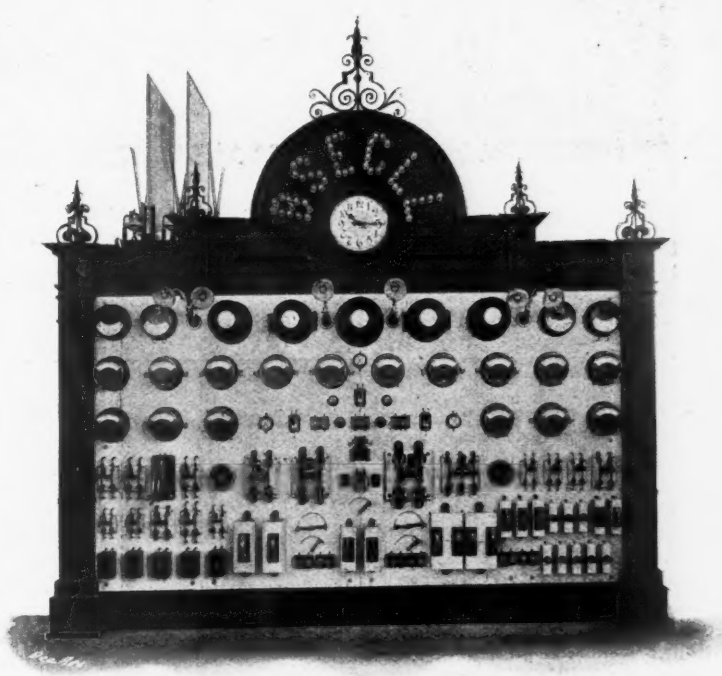
Another prominent feature of the Pavilion is an electrically-driven winch. The drum shaft is fitted with two drums, and is driven through double reduction machine-cut gear by a two-pole motor of 12 H.P. A friction clutch is introduced after the first reduction, to relieve the motor when starting up. The machine is provided with a magnetic blow-out controller for starting and reversing, and with special gear for automatically cutting off the current when the limit of raising or lowering has been reached. The motor is series wound, and runs at 450 revolutions per minute, with a supply pressure of 500 volts. Foot, hand and electric brakes are provided, interlocked with the controller, so that the motor cannot be started while the brake is on, and *vice versâ*.

The crab of a 20-ton overhead travelling crane, made by Messrs. Joseph Adamson & Co., of Hyde, forms another exhibit. This is mounted on elevated rails at the back of the room.

The rails are supported by four girder columns at a height of 16 ft., and afford a travel for the crab of 20 ft. The hoisting motor has a capacity of 10 H.P. at 500 volts, 500 revolutions per minute; the traversing motor is of 5 H.P. output at 500 volts, 440 revolutions per minute, and both motors are series wound. A marble switchboard fitted to the girders carries the necessary measuring and controlling instruments.

The motors are provided with electric brake-release devices, and the load is lowered electrically without the aid of a mechanical hand brake.

An elaborate arrangement is provided for the purpose of showing the Schuckert high pressure switch in operation. A six-pole direct current shunt-wound motor, receiving current from the Corporation system at 500 volts, and taking up to a maximum of 220 amperes, is coupled, by means of a flexible



Schuckert Pavilion: Main Switchboard.

The 10,000-volt switch is shown at the left-hand top corner.

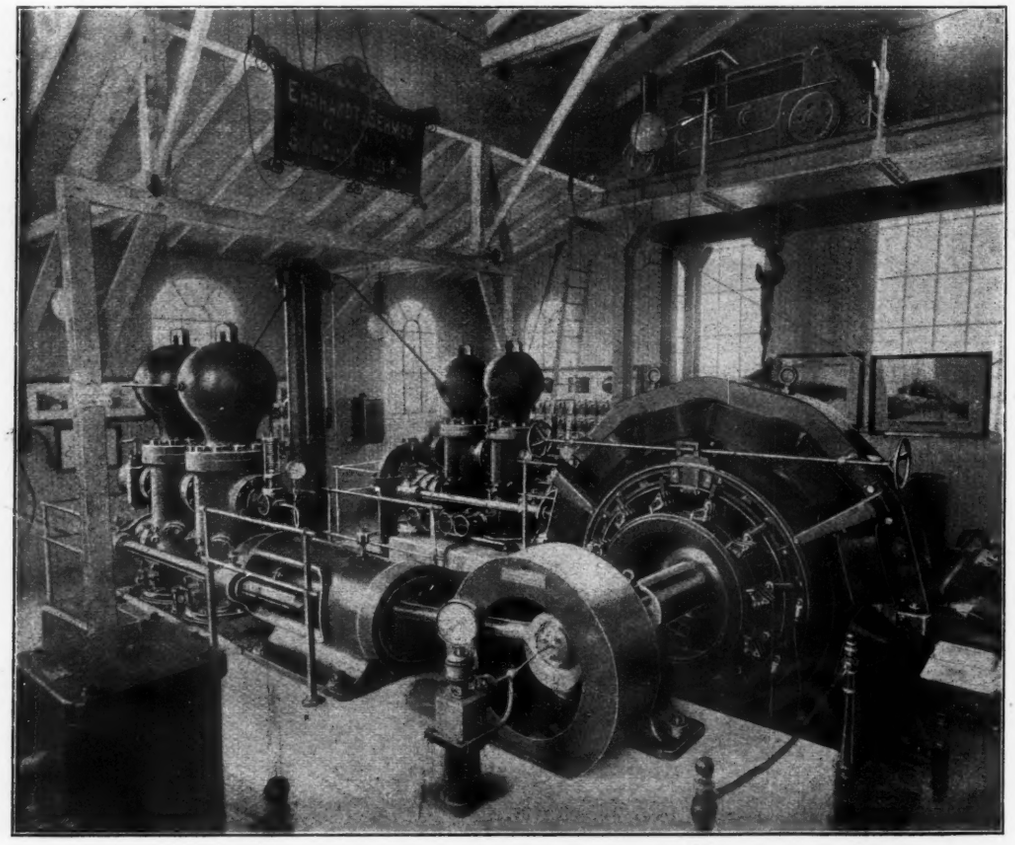
leather coupling, to a 100-KW. three-phase generator, which gives 120 amperes in each phase at 500 volts, running at 500 revolutions per minute, with a frequency of 50. The exciter, a two-pole machine with drum armature, is mounted on the end of the alternator shaft. The generator is connected with a transformer, which raises the pressure to 10,000 volts. The secondary (high-pressure) side of the transformer again is connected with a water load by way of a three-phase high pressure switch, consisting of three double-break switches of the chopper type, surmounted by stout wire horns, in the shape of the well-known Siemens lightning arrester. With this a load of 100-KW. at 10,000 volts is broken with no trouble whatever; the circuit is last broken on the lower part of the horns, and the arc is carried up by the current of heated air which it induces, humming loudly, until it becomes too long to continue, and breaks down. The individual switches are separated by slabs of marble. Such switches are used for the transmission at 20,000 volts between Lavoisière and Limoges, with 1,000 H.P. on the circuit, and are found to be highly satisfactory. It is noteworthy that the switches are built up on porcelain insulators, and the high pressure cables are similarly supported.

An extremely handsome switchboard, of which we give an illustration, is used for controlling the various apparatus in the Pavilion. It consists of slabs of white marble, carried by an iron frame. The measuring instruments and controlling gear are mounted on the front of the board. The back is arranged on the usual Continental style, with iron frames carrying porcelain insulators, which support the bare conductors.

Two electrically-operated drills, made by Messrs. Collet and Engelhard, of Offenbach, are exhibited. These stand on wheeled trucks. Each of them is driven by a 1½-H.P. direct-current motor mounted upon the pillar, running at 1,200 revolutions per minute with 250 volts, and driving the mechanism by means of a ball-and-socket-joint shafting. The motors are enclosed in covers, and the starting resistances are mounted on top of the motors. One of the machines is a portable drilling and thread-cutting machine for boiler work; the other is a radial drill.

Behind the switchboard is a separate room, in which are exhibited a number of rock drills. Two of these are spiral drills intended for cutting coal and other soft minerals; other two are diamond drills, for drilling stones and rocks which contain no quartz, and are specially suitable for stone quarries. These drills are driven by three direct current motors, running at 1,500 revolutions per minute with 250 volts terminal pressure. Two three-phase motors are provided in working order, but cannot be shown in operation on account of patent rights. A separate marble switchboard is provided for the drill motors.

Other exhibits within the Pavilion relate to electric traction. A Brill truck equipped with two Schuckert motors, type A.B. 66, is shown; the motors are series wound, and run at 530 revolutions per minute. A motor of type A.B. 55, and accessories for the equipment of a motor car, are also shown. The Schuckert surface contact system is illustrated by a collection of apparatus, including a switchboard equipped with 27 contact relays. The latter is shown in operation, the car being represented by a simple switch mechanism. The system was described in our issues of February 15th and 22nd, 1901. An automobile motor, type A.B. 102, with controller, is exhibited.



SCHUCKERT PAVILION: DOUBLE-ACTING PUMP DRIVEN BY SCHUCKERT MOTOR, &C.

Outside the Pavilion is a railway about 200 ft. long, laid with two gauges to suit two locomotives, one a mining locomotive with trolley, the other an accumulator locomotive. The latter has been in actual use for many years; it is equipped with two motors, taking 32 amperes each, and a battery of 39 cells, type G.O. 80, having a one-hour rate of discharge of 63 amperes, 70 to 75 volts. The trolley locomotive is fitted with two motors, taking 18 amperes each at 250 volts. A motor-generator is used, driven by the Corporation supply, to charge the battery.

The Exhibition authorities have provided two leads to the

Pavilion, one having a capacity of 410 KW. at 500 volts, the other 15 KW. at 250 volts.

A windlass made by Mr. F. Schmiedel, of Niederwürschnitz, driven by a 7-H.P. motor, is shown running light, and a Schuckert searchlight projector, type G. 150, is at work on a tower 40 ft. high, near the Pavilion. The projector is controlled from the foot of the tower.

The Pavilion is lighted by eight 10-ampere arc lamps, running four in series on 250 volts; five similar lamps are erected outside the building, and connected to the same circuit.

THE INSTITUTION OF ELECTRICAL ENGINEERS IN GERMANY.

IV.

THE most interesting, as the most up-to-date, of the electricity works of Berlin, are the two which have been erected outside the city, viz., the Moabit and Oberspree stations. These generate current at 6,000 volts on the three-phase system, with a frequency of 50 cycles per second, and transmit it by underground cables to sub-stations, six in number, within the area of distribution. The capacity of the two stations is to be very considerable, that of Moabit being 36,000 H.P., and that of Oberspree no less than 54,000 H.P., so that the latter will eventually exceed the present power station at Niagara in output.

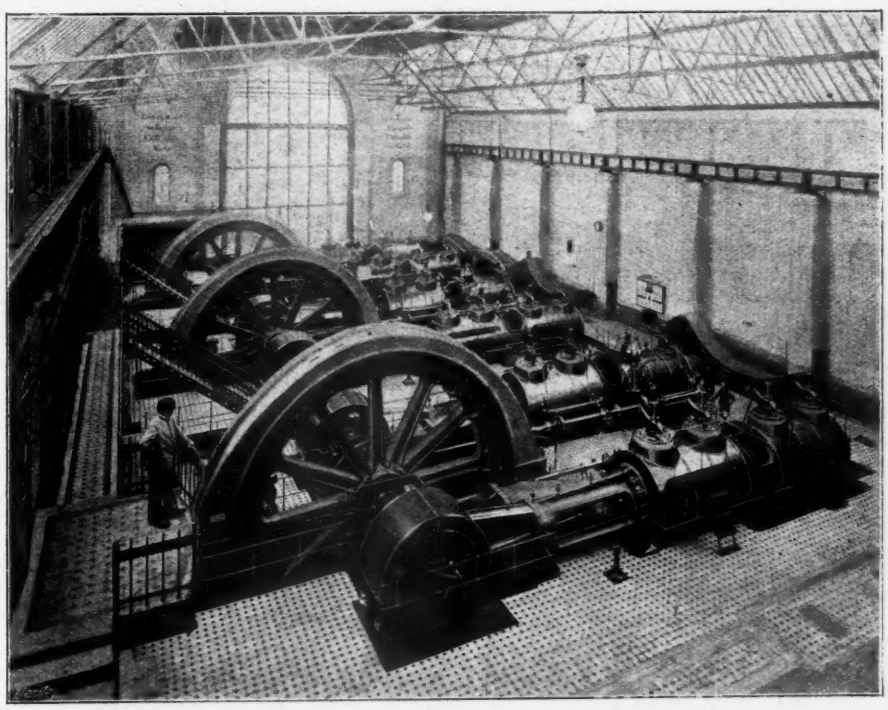
The machinery in the Moabit station presents a very imposing appearance, there being three generators installed, each of 3,000 KW. output. These are driven by low-speed Sulzer engines, and the combination forms an extremely fine piece of work. The engines are of the triple-expansion condensing horizontal type, with four cylinders, two on each side of the alternator, the rotating field magnet of which is mounted direct on the crankshaft.

The main switchboard is fixed on a gallery running along the wall of the engine room, and commanding a clear view of the generating machinery. The engine room is lofty, and is lined with white enamelled brick, while the floor is paved with tiles, the whole forming an ideal machinery hall.

At the Oberspree station, which is not far from the cable works of the A.E.G., and 9 miles from the city, there are three similar generators, driven by horizontal engines. In addition to these two 1,000-KW. generators are installed, driven by horizontal engines, and four inductor generators of 600 KW. each, driven in pairs by vertical engines. These are shown in one of our views.

MAIN SWITCHBOARD IN SUB-STATION.

All the engines are of the Goerlitz Foundry Company's manufacture.

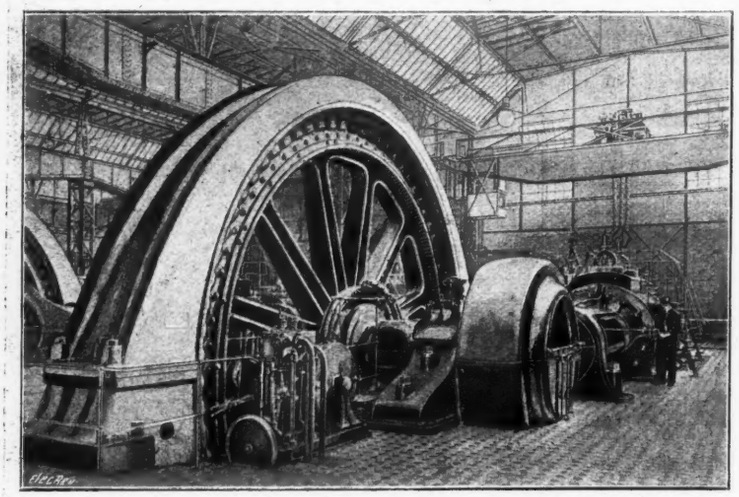


BERLIN ELECTRICITY WORKS: ENGINE ROOM AT MOABIT STATION.

The boilers are of the water-tube type, with economisers, and superheated steam is used. The station is close to the river, and coal is conveyed direct from the wharf to the boiler room.

An additional 3,000-KW. set is in course of erection, and eight more are being constructed.

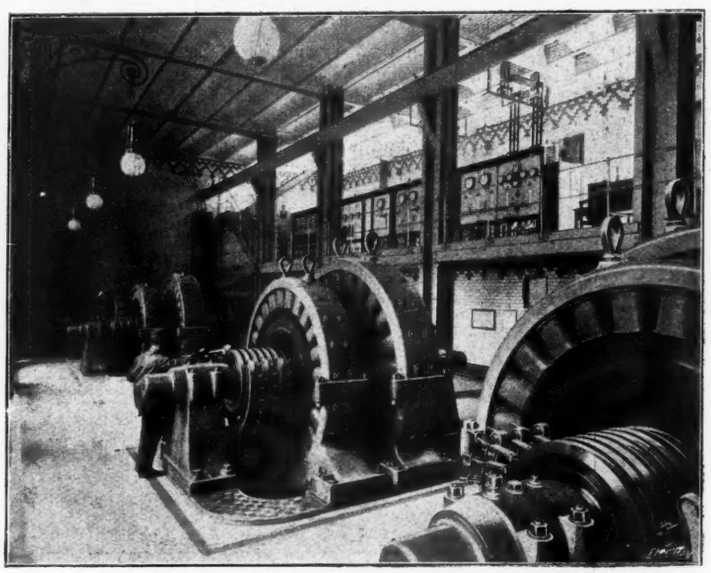
The sub-station visited by the members of the party was that at the Königin Augusta Strasse, where four six-phase rotary converters are installed. These converters are of a peculiar type, and caused much discussion among the visitors. Instead of the induction regulator usually employed for varying the ratio of conversion from A.C. to D.C., each rotary is combined with an alternate current booster, the armature of which is mounted on the same shaft as the armature of the converter. Before entering the latter the alternating currents have to traverse the windings of the booster, and as the excitation of the field magnets of the latter is independently controlled, it is possible to vary the conversion over a very wide range—about 20 per cent. either way from the mean.



Berlin Electricity Works: 3,000-kw. Generator in Oberspree Station.

The transformers are placed in a special room above the switchboard gallery; they are of the oil-cooled type, and are coupled up to give six-phase currents on the secondary side.

A separate switchboard is provided for each rotary converter, provided with measuring and controlling gear, all of which is electrically inert, so that personal safety is ensured. Hand wheels for operating the regulating and starting resistances are mounted on pillars in front of the boards, as shown in our illustration of the main switchboard gallery. The latter also shows the arrangement of the copper bars which connect the transformer secondaries with the switchboards, as well as the switches themselves and the construction behind the board.



Königin Augusta Strasse Sub-Station.

ENGLISH AND AMERICAN RAILWAY SIGNALLING.

By J. PIGG.

(*Concluded from page* 664.)

If a comparison is instituted between the methods described and the systems of signalling in use in this country, it will be found that the essential difference consists in the control of the signalling. In this country, where nearly all the signalling is manually operated and manually controlled, such control is inevitably vested in the signalmen operating individual blocks, and the responsibility is shared between them within easily ascertainable limits. In the States, in the higher development of signalling, control is exercised by the train itself *by virtue of its position*. With trifling exceptions, the highest development in this country is comparable only with the controlled manual in America. The "Lock and Block" systems, of which those of Messrs. Sykes, Langdon and Spagnoletti respectively are examples, are all the English equivalent of the American controlled manual, since they all aim at no more than acting as a check upon the movements of the operator by making the operations for signalling each train cyclic. Even when a cycle of operations has been completed, it is not absolutely certain that the line is clear throughout the whole of the section controlled, since the last operation in the cycle is made indifferently by one or a number of vehicles passing over the releasing treadle or track circuit; and the signalman must satisfy himself by personal observation that the whole of a train has passed before he can avail himself of the implied permission to make further use of the apparatus, which is given by the release of the locking by the passage of the first vehicle over the releasing arrangement.

That all the operations for the signalling and marshalling of trains cannot always be carried out in an unvarying cycle is well known, and this irregularity of working involves the use of releasing keys, which, whilst convenient for the despatch of traffic without undue delay under special circumstances, are a source of weakness, and a violation of the principle of train control which the apparatus has been designed to establish. It is true that the use of the releasing apparatus is hedged about with rules governing its use, and that reports concerning the circumstances under which it is used may be called for, but it need hardly be said that these have not always been successful in averting serious consequences. Where such use is made under misapprehension, neither rules nor subsequent reports will affect the consequences arising therefrom.

There are, of course, reasons why the trend towards the use of automatic signalling should be more pronounced in the United States than in this country. Automatic signalling, whilst the ideal system for lines where long distances have to be run between diverging points, fails in that it

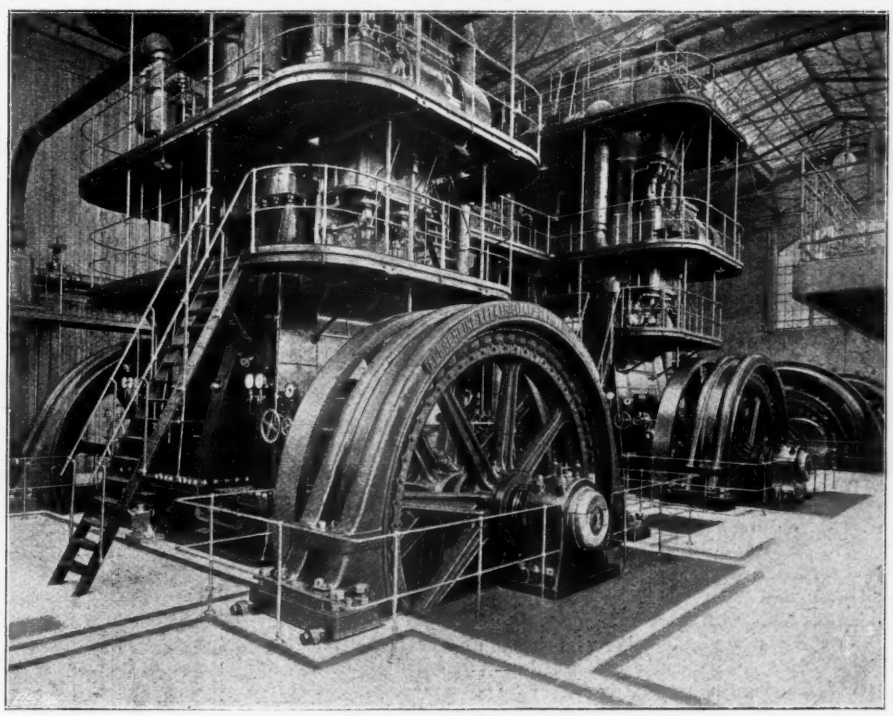
exercises no selective action, and is therefore unsuitable for use at junctions. A consideration of the conditions under which switches between block points are operated under automatic systems gives an excellent idea of the non-selective properties of such systems. In this country junctions are numerous, and the operations at such points must necessarily be selective. Under such conditions as exist in this country, it is safe to say that the great bulk of the signalling operations *must* be, at the best, made under some form of "Controlled Manual." This, of course, does not imply that there are not many places where automatic signalling *might* be used. On the contrary, such places are numerous, but they do not necessarily form *consecutive* sections.

It must not be forgotten that unremedied defects in apparatus, where automatic signalling is in operation, demand rules to allow a train to pass a signal when at "danger," after a certain arbitrary time stop, since there are no means of advising the driver that his delay is not being caused in the way the design of the apparatus was intended to meet. Hence signals which are operated automatically must be distinguishable, by the driver, from those under manual control, which he must not pass when at "danger" without special authority from the controller. Hence, under the conditions obtaining in this country, the adoption of automatic signalling in those places where it would be suitable, would cause the driver to alternate between automatic and manually operated signals at short intervals throughout the journey, and it is extremely doubtful whether such a hybrid system would be of any advantage, or as safe as the present system even.

It is of some interest to note how the essential principle of the higher development of American signalling—control of the signals by the train—is also evident in the apparatus described as for use in cases where the driver neglects his duty, and attempts to pass a signal at danger. In such cases the apparatus is designed to perform the office which the driver has neglected. In this country, however, where Messrs. Raven, Brierley and Boult respectively, and others, have designed apparatus on somewhat similar lines, the effect of the special apparatus provided is to call attention to the dereliction only, leaving the operation to be performed by those whose duty it is. It seems to be a characteristic of the design of American apparatus that it must do the thing required directly.

After all, it is by no means certain that automatic signalling apparatus—admirably as it may and does suit the conditions on American railways—would be a success in this country, where, as has been shown, the conditions are totally different. The results obtained in English railway signalling are second to none, and are a splendid tribute to the care exercised by those engaged in the movement of traffic. It is, of course, not difficult to point out weak places, which seem likely, under certain combinations of circumstances, to lead to serious results, and events sometimes demonstrate the validity of the objections urged. In the great majority of cases of serious accident, however, it will be found from a careful study of the Board of Trade inspectors' reports that the results have been due to misapprehension on the part of someone engaged either in controlling the traffic or in moving it. The weakness of the system lies in the manual operation and control; not because gross carelessness can be urged against the operators at fault, but because they are human, and so have other interests and claims on their attention which will force themselves under their notice whether they will or no. Such lapses are due to absent-mindedness, and there seems no essential difference in the causes which lead one man to leave an umbrella in the train, and another to cause an accident, beyond opportunity and the consequences. Neither would do so designedly.

No doubt further limitations will be put upon the actions of those engaged in the movement of traffic eventually, but, as already observed, the lines on which improvements are proceeding do not promise absolute perfection, and human control and operation will still be required. Mr. J. P. Coleman, whose excellent article in the *Wisconsin Engineer* for May, 1899, has been laid under considerable contribution by the writer, says, "*The safest method of operating a railroad is to provide a track for each train operated*," but dismisses the proposition as impracticable. Obviously, then, absolute safety is unattainable, a conclusion that might be obtained from quite other lines of reasoning.



Berlin Electricity Works: Generating Sets in Oberspree Station.

Canada.—The Ampere Electric Manufacturing Company is the title of a company which has just been formed in Montreal with a capital of £10,000.

CORRESPONDENCE.

Examination Test for Electrical Engineers.

In reply to "The Booster of the Middle Wire," I would like to state that I think that he has voiced not only mine, but the sentiments of a great number of engineers who have the interests of the profession at heart. I can hardly conceive any greater blessing than a test whereby a damper would be put on some of the so-called engineers. It seems to me at present that all the posts of any good are obtained by those who have influence and glowing testimonials; whether they are competent or not is a matter of secondary consideration. I therefore think that it is high time that a movement was set going whereby all those who called themselves, and practised as, electrical engineers were bound to give some proof of their qualifications.

L. Francis Fogarty.

London, *October 25th*, 1901.

Will you allow me as the father of an electrical engineer to endorse every word said by "The Booster of the Middle Wire," on the subject of an examination for the profession of electrical engineer?

I have given my son a thorough training at considerable expense. He took the three years' course at Faraday House with distinction, taking the highest place in the final examination. After that he went into a mechanical engineer's workshop for 18 months. He holds first-class South Kensington certificates for drawing, mathematics, and applied mechanics, has had charge of the evening run at a good-sized lighting station, has had a year's experience as superintendent in cable-laying, and yet has just had the mortification of seeing a man who, to use the words of your correspondent, has had "a couple of years manipulating the switches and writing the logs of the switchboard," preferred before him.

Having no influence in the profession, he in vain seeks an assistantship at £3 a week, whereas, if he had had to qualify by examination, he would probably have taken a good place and have obtained good work.

As I am writing, I should like to ask, "on what principle (if any) are advertised positions filled?" My son recently applied for a post advertised in your columns, only to find that the post had been filled before the day for sending in applications had been reached.

As regards "the everyday grocer and baker who sit upon electricity committees," the following actually occurred:—A certain town adopted electric lighting some three or four years ago. When the chief engineer was about to be appointed, a local publican, who had been a fitter, applied for the post, and his local interest was such that he would have obtained it, if it had not been for the consulting engineer, who managed with some difficulty to upset the job.

From the knowledge I have gained lately, I feel convinced that no profession is so thoroughly honeycombed with quackery as that of electrical engineer, and that an examination is imperatively needed to sort out the incapables. In the meantime I would suggest that you opened a bureau where men of proved competence could register their names, and to which chief engineers and others could apply when in search of competent men.

I do not as a rule write anonymously, but for obvious reasons I cannot sign my name to the above; but I am prepared, Sir, to substantiate every one of the above statements privately to you.

Pater.

Duplicate Electricity Feeders.

In your issue of May 27th, 1898, you described and illustrated a system of duplicate mains, devised by the writer, for the purpose of preventing an interruption to the supply in the event of a short circuit occurring on any feeder. Since that time a number of experiments have been made to test the reliability of this system, but it is only within the past few months that it has been introduced into practical use. Shortly after the duplicate supply to one of the principal sub-stations at Hastings had been completed, a bad short-circuit occurred on one of the duplicate high tension feeders supplying this sub-station. The faulty section was immediately automatically disconnected, and the supply to some thousands of lamps was maintained through the remaining feeder.

The feeders are connected up as shown in the accompanying diagram. The transformers, in the sub-station, T1, T2, &c., are supplied from two independent high-tension bus bars, half of the transformers being on one bar and half on the other. These bus bars are fed by means of the duplicate feeders, A1 and A2, with current from a common source of supply at the generating station. High tension fuses, F1 and F2, are inserted in series with these feeders at the generating station end of the same. These feeders are not directly connected together at the sub-station end, but are indirectly connected through the transformers, since the secondary of each transformer is connected to a common L.T. bus bar. High tension fuses, H1, H2, &c., are inserted in series between the primary winding of each transformer and its bus bar, and means are provided for directly connecting the two high tension bus bars in parallel by inserting the inter-connecting fuses, C1 and C2. High tension switches, S1 and S2, are provided for disconnecting the H.T. feeders from the bus bars. Return current cut-outs, R1, R2, &c., are inserted between the secondary of each transformer and the low tension bus bars. A pilot wire is run from the sub-station to the generating station for the purpose of indicating at the latter the pressure across the low tension bus bars in the sub-station. A small auxiliary switch X on each of the low tension cut-outs is connected in series with this pilot wire; the object of this arrangement being to signal to the generating station the opening of any L.T. cut-out due to the failure of any transformer to maintain the supply.

When the short-circuit referred to above occurred, a momentary roar was heard on the generators, and it was noticed that the needle of the pilot voltmeter connected to the particular sub-station referred to had fallen to zero, thus indicating that one or more of the cut-outs in this sub-station had opened. On going to the sub-station it was

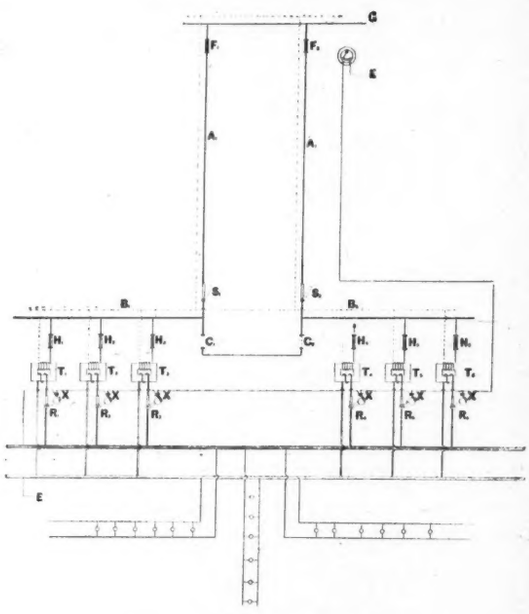


Diagram of Feeder Connections.

found that the cut-outs, R4, R5 and R6, had opened, thus showing that a current had been flowing back from the L.T. bus bar into the transformers fed by the feeder A2. It was at once concluded that this feeder had short-circuited. The switch, S2, was, therefore, opened, and the return current cut-outs, R4, R5 and R6, were closed, thus magnetising the transformers that had been cut off through their secondaries. This showed that there was no fault in

these transformers. The inter-connecting fuses, C1 and C2, were, therefore, inserted, and the whole of the transformers in the sub-station were supplied through the healthy feeder, A1. On examining the fuse, F2, it was found that this had blown, thus confirming the conclusion that the short-circuit was in this section. The faulty feeder was tested and the fault localised. It was found that the short-circuit had started in an old rubber-tape joint, which had apparently been attacked by the sea water. The arc had evidently been a fairly destructive one, as it had burnt out a foot or two of 19/16 cable before the fuse had blown.

As the fault occurred at the time of maximum load, it will be obvious that if fuses had been used between the secondaries of the transformers and the low tension bus bar, the supply to this bus bar would most certainly have been interrupted, because the three transformers on the healthy side of the sub-station would have had to maintain the whole of the load taken over from the transformers on the faulty side, in addition to supplying the current necessary to blow the fuses on the faulty side, and would certainly have blown their own fuses first.

Leonard Andrews,
Borough Electrical Engineer, Hastings.

The Ethics (?) of Ordering Machinery Abroad.

The earnest communication of Mr. Percy Rosling in your issue of the 25th concerns the neglected science of economics, and is scarcely, if at all, an ethical matter.

All business resolves itself ultimately into barter, the exchange of one commodity for another, the cash payment being but an intermediate step in the process.

If certain nations have exchanged with us a portion of their labour and materials during the year, for £600,000, it is because they desire eventually to exchange this money for commodities of which they have need, and in procuring for them the wools of England, the wines of France, &c., that money will continue to circulate around and benefit all those communities where man, in his business relations, knows ethics only by the name of "commercial honesty," and buys his bread wherever they give the biggest loaf for a penny.

To take a concrete case: If certain capitalists desirous of establishing street railways were to reverse their usual and natural method of accepting the most favourable offers for plant, and insist on buying within the country, even at the cost of delay, and devote capital to assist in increasing the productive capacity of the plant manufacturer, the result would be to raise the price of the machinery, owing to the increase in wages which would follow the extra demand for labour, hence increased capital expenditure of the railway undertakings, and consequently the passengers would have to pay a higher fare, or the shareholders be content with a lower dividend. In either case the gain to the producers, and those who supply their needs, would be practically counterbalanced by the loss to the passenger and investor, possibly leaving the wealth of the community unchanged, if not reduced, by a measure which at first sight promises to enrich it.

We are often alarmed because, in our impatience, we fail to observe the slow yet exceeding sure equilibrating action of natural economic laws, when, as in this case, allowed full play by the existence of a free competitive system. If the prices of foreign machinery to-day are such that we cannot compete with them at home, buyers will continue to go abroad, with the result that the persistent demand will raise those prices until a point is reached at which we can also secure a market.

J. W. B.

Electricity v. Other Illuminants.

It was with much pleasure that I read "Luminosity's" introduction of the above subject, because it is one which ought to be brought prominently before the public at the present time, when so many other systems are being boomed; from the absurd statements made by those who put the different systems on the market, it is difficult to find on what basis they form their calculations. For instance, gas may vary from 1s. 8d. per 1,000 cb. ft. in one town to 4s. per 1,000 in another; on the other hand, electricity varies from 1½d. per unit in one town up to 8d. in another town.

At the time when the evidence was given in favour of the Yorkshire power scheme, one electrical engineer, in his evidence, stated that the cost of generation per unit was only ¾d. with the firm he represented, and from reliable working results at many of the large firms where the installation is fairly large, the cost per unit generated is well under 1d.

I see in the book issued by the "Kitson Light" that they claim that they can produce a better light, at nearly a quarter the cost of the electric arc lamp. Now in their best results the cost of the Kitson light very nearly reaches 1d. per hour, and that is based on the fact that a "labourer" looks after 50 lamps, cleaning and doing minor repairs. I fancy that if two "labourers" started at the same time, the one to trim 50 arc lamps and the other 50 "Kitson lamps," the result would be favourable to the arc lamp "labourer."

If we take some of the well known arc lamps, such as Johnson & Phillips's enclosed type, the power used by them is 600 watts, therefore $\frac{6}{10}$ths of a unit is consumed per hour, and in the large firms where the cost may be roughly taken at 1d. per unit, the cost of one hour's burning of the above lamp may be taken as $\frac{6}{10}$ths of a 1d.; the cost of carbons for 60 hours' actual burning is about 3¾d. for the lamp, so that with trimming, &c., the cost should be well under 1d. per hour, this allowing a big margin for repairs. In other types such as open type arc lamps, the cost of one hour's burning is well under a 1d. On what basis do the "Kitson" light adherents work, when they claim that it is four times cheaper than the electric arc lamp?

I believe Sir Michael Hicks-Beach once said that figures would prove anything, and it is an opportune time for some of our electrical engineers to come forward and expose the statements made by some of the opponents of the electric arc. Certainly there are cases where the Kitson light may be considerably cheaper than the electric arc, especially where the energy is purchased from a corporation at 3d. or 4d. per unit, but I do not for one moment believe that 1d. per hour will cover the cost of Kitson light in every case. I should like to hear from some of your readers on the above subject.

Fair Play.

October 21st, 1901.

Re "Supply Station Accounts."

I am obliged for your kindly criticisms of the Tunbridge Wells electricity accounts in last week's issue, but take exception to the remarks made with respect to "cutting down salaries," which is giving us credit for what does not take place, nor am I aware that we are paying any single man on the works *less* than what he would receive in other towns; in fact, the long service rendered by all the staff in this department, proves the general satisfaction existing. As, no doubt, you have formed your opinion from figures, I take the liberty of putting before you the following:—

Town.	Units generated.	Wages of workmen.	Management expenses.	Total.
Bath	388,904	£776 8 1	*£1,294 0 6	£2,070 8 7
Bedford ...	540,146	765 4 1	*562 13 0	1,327 17 1
Coventry ...	341,810	1,068 3 1	*655 2 8	1,723 5 9
Leyton ...	423,476	970 9 3	*1,041 0 10	2,011 10 1
Southampton ...	526,554	614 6 3	*943 8 2	1,557 14 5
Croydon ...	1,074,655	686 0 0	*2,152 0 0	2,838 0 0
Tunbridge Wells	564,827	885 0 0	*1,203 6 6	2,088 6 6

* This includes stationery, printing, law charges, insurance, and general establishment charges.

And therefore, the town, instead of being "notorious for economy in wages," has, unfortunately (or otherwise), to pay more for its men than other towns, as the scale below shows:—

Chief engineer	£500 0 0	per annum.
Assistant engineer	150 0 0	„ „
Mains superintendent (commencing at)	100 0 0	„ „
Engine drivers	1 16 6	per week.
Stokers	1 10 0	„ „
Labourers	26s. to 30s.	„ „

Although we are all living in hopes of higher salaries, as the works progress, we rather resent that particular criticism,

and I have yet to find a staff more efficient than my own—which I am proud of. It will be interesting if you can quote the wages paid by other towns with a similar output, as I happen to have before me a list of the wages paid in other towns, and I find that we pay considerably more, but then, as I have said, our staff of men is most efficient.

Horace Boot,
Consulting and Resident Engineer.

Tunbridge Wells.

Multiplicity of Tenders.

We wish to endorse as strongly as we can the very sensible remarks regarding the present practice of combining engine and dynamo tenders dealt with in your leading article of last week. We ourselves, in common, we believe, with practically every other dynamo manufacturer in the country and engine builder as well, have found recently that the preparation of tenders for combined sets has necessarily embraced the inclusion, with each tender, of so great a number of alternatives as to involve an immense amount of trouble and a considerable expense. We have no doubt that in most cases at present, owing to the keenness of competition, the total number of tenders has been so large as to entail a correspondingly great inconvenience to the consulting or other engineer, who has to consider the tenders submitted. The remedy which you propose is at once simple and direct. It will remove from the electrical manufacturer the necessity for being a middleman for the supply of engines which he does not himself build, and will enable the purchaser to buy direct from the engine manufacturer without the addition, which should fairly be added to cover a middleman's profit.

Another point of some importance is that it will make much more certain the attainment by the purchaser of all the advantages to be gained by the practice of secret competitive tendering.

We trust that consulting engineers will, equally with manufacturers, see matters from the point of view which you have put forward, since it involves no practical drawbacks worth considering, but will tend to relieve the present unnecessary multiplication of labour required in the preparation and consideration of tenders for this class of work.

Dick, Kerr & Co., Ltd.

London, E.C.,
October 28th, 1901.

Pay of Assistant Engineers.

On looking over your column of vacant appointments from week to week one cannot help being struck by the very poor salaries offered to assistant engineers in central stations.

This is the more obvious seeing the huge financial success of all central lighting and power stations, and it seems but fair that those who have the working of them should receive a proportionate share in the success to which they contribute.

Surely a young man who has gone through the arduous and expensive training of an electrical engineer must be worth more than the paltry wage offered him, which, in many cases, is no more than that given to the artisan or mechanic.

I think the views of all central station engineers, both chief and assistant, would be interesting on this point, especially to those younger members of the profession who have yet to strike out a line for themselves.

I notice one particular instance in this week's Review, where an assistant engineer is required at King's Lynn at £78 per annum. The advertisement asks that particulars of experience should be given, so that the successful candidate must have already held a similar post.

Surely it is scarcely worth any young man's while to spend five or six years of his life learning a profession which at the end of those years is going to bring him such a huge reward.

Seeing what the electrical engineer has done, and is doing, in every way for the benefit of mankind in general, this seems scarcely the way to reward him and encourage him to fresh labours, and many young fellows who would perhaps make their mark in the profession are beginning to think whether the game is worth the candle.

Justitia.

Coal Consumption per Unit in Power Stations.

In reply to "C. E. D." and other correspondents *re* above:—

Owing to reasons which cannot be made public, I regret I am unable to accede to their requests, and give the type of plant in use at the power station.

I may, however, say in answer to "C. E. D.'s" query No. 1 that we use Welsh pea coal.

Our experience with the cheaper coals has shown a slightly increased cost (due to increased bulk of fuel and ashes), over that of the dearer, also extra labour of firemen, besides more wear and tear of furnaces.

Query No. 4.—The steam pressure is 160 lbs. per sq. in., and saturated.

5. The coal consumed covers that required for generation of steam for steam-driven auxiliaries.

The total units include those required for electrically-driven auxiliaries and lighting purposes, which amount to 5 per cent. or 6 per cent. of the total.

The load factor was found by simple proportion—for example:—

If the units generated in 16 hours = 10,000, and the output of the station at normal full load for a like period = 20,000, it is evident that the load factor = 50 per cent.

"W. R." appears sceptical as to such results (*i.e.*, 2·1 lb. per per unit) being obtained in practice.

I would have replied sooner, but have been waiting for the completion of improvements which I expected would show improved results. I am now in a position to inform "W. R." that the coal consumption has been on several occasions brought below 2·0 lb. per unit, in fact, on two or three occasions below 1·9 lb.

W. H. J.

[See also our "Notes" columns.—Eds. Elec. Rev.]

Continuous Current Dynamos.

Referring to Mr. Claude W. Hill's letter in your issue of October 18th, the discrepancy between the calculations of the reactance voltage arises from the fact, that my calculations assume that the maximum number of sections of the commutator covered by the brush is a measure of the number of coils under commutation simultaneously, and therefore, also of the reactance voltage, and this assumption is not always in accordance with Messrs. Parshall & Hobart's method of calculation, which assumes that the *maximum* number of coils short-circuited by the brush is the measure of the reactance voltage.

It appears to me that the method I have adopted is the more accurate one, and I regret that it did not occur to me that this discrepancy, which I observed at the time my paper was written, was what was troubling Mr. Hill. If it is not right to take the angular width of the brush as the measure of the number of coils under simultaneous commutation, it would not appear right to take this same dimension as a measure of the periodicity.

Henry A. Mavor.

Glasgow, *October 29th*, 1901.

Trade Discounts, and the Abuse of Them.

On no point is that long-suffering individual, the wiring contractor, more sore than on the question of trade discounts; and well he may be, for there is no trade privilege that is more abused. In these days of keen competition, it not infrequently happens that the contractor has to look to his discount on the fittings for his profit on the job, so that he thinks himself very ill-used if he is informed by his client that he has been to Messrs. So-and-So and arranged about his fittings. When the wholesale houses are approached on this question, they invariably say that they never allow discounts except to the trade and shippers. Blessed word that "shippers"; it is surprising how quickly any draper or other tradesman who requires 50 lamps becomes a "shipper" in the eyes of these wholesale houses, or how soon an ironmonger, builder or furniture dealer, becomes an "electrical engineer and contractor," should he need half-a-dozen switches and a coil of wire. But it is in connection with private persons that this injustice is most keenly felt. Any person may walk into some of the largest houses and order

fittings, and receive the full trade discount on them, which seems to be a practice distinctly unfair to the legitimate contractor. That this sort of thing could be stopped, or, at any rate, greatly reduced, I am firmly convinced, but nothing can be done unless wiring contractors combine, and bring their full strength to bear on the question.

It is not merely supposition that prompts this statement, but actual knowledge of what has already been accomplished in this direction, more than one case having come under my observation in which the contractor has received a further discount, over and above that already given to the private consumer, as a result of pressure being brought to bear in the matter. This statement I can support with documentary evidence should it be questioned, and am perfectly willing to do so, should any contractor be sceptical on the subject. However, no great reforms have ever been accomplished without the combination of the persons concerned, and unless electrical contractors awake to the necessity of combining together for the general good, this grievance, as well as many others, will remain unredressed.

Sidney Frost,
Secretary, London Electrical Contractors' Association.

THE UNDERGROUND RAILWAY ELECTRICAL INQUIRY.

On Tuesday morning the Hon. A. Lyttleton, K.C., M.P., the arbitrator appointed by the Board of Trade, sat in the Lord Chief Justice's room of the Law Courts to decide upon what system of electrical traction should be applied to the Metropolitan Railway and the Metropolitan District Railway.

Mr. Fletcher Moulton, K.C., in opening the case for the Metropolitan District Railway, first described the lines intended to be electrified, and proceeding, said it was a very serious undertaking to convert something like 30 miles of London traffic from steam to electricity; considering the radical difference of motive power, it would make anyone pause if it was a novel thing. In that case his clients felt there was no need to take a leap in the dark. There was a vast amount of experience in the conversion of steam traffic into electric traffic under conditions not far removed from those in the present case. The risk being taken was not a risk complicated by what he might call electrical difficulties, but it was merely a financial risk, depending on the probable traffic which they could secure by the change, and the actual expense of making the change and working the new system. His clients felt that, properly speaking, there was no electrical risk in this case, because of the experience that existed of success. At present, in America, there were 21,000 miles of electric traction. He did not say they were all railways, for most of them were of the type which they called tramways, but which, so far as the passenger traffic was concerned, were merely a lighter form of railway. Certainly, a respectable number of miles might fairly be called miles of railway as opposed to tramways. Indeed, some of the systems of Chicago and New York were comparable to anything they had to deal with in that case. Great Britain lagged behind terribly, and they had only 908 miles of electric traction as compared with 21,000 miles in America, but still, 908 miles gave a considerable amount of experience. All this had been done within the last 20 years. He remembered in the Electrical Exhibition of Paris in 1881, the tremor which ran round when a car ran for some 80 yds. by the overhead trolley—it was the baby prototype of the many thousands which had since been working. But the whole of the progress had been made with very few checks. No doubt an enormous amount of money had been expended in experiments, and a number of systems had been suggested and tried and put on one side, but there had been a steady approach to one definite type of electric traction which had been found to answer all the requirements of the case, and although, no doubt, each maker had his particular pet dimensions and motors, on the whole it might be said that electrical engineers had unanimously adopted one characteristic system with which the most satisfactory results had been obtained. Mr. Fletcher Moulton proceeded to deal with the system generally adopted—through a rail or through a wire conducted overhead, the motor took in its current; it passed through this motor, which was the same thing as the dynamo on the car, and it passed out again to a second conductor or the rails, and so was conducted back to the generating station. That caused the motor on the car to revolve. There were two things to be considered. They had to consider the amount of the current and the pressure at which that current was driven. The great difference was that the size of the conductors depended solely upon the quantity of the electricity. The precautions they must take to insulate the electricity depended on the pressure, but the size of the conductor depended entirely on the quantity of the current. The consequence had been that there had been rather a struggle between electricians and the public, the latter trying to compel electricians to have a small pressure, which should not be dangerous. As usual in such cases, a mean had been arrived at, which was practically universally observed. The pressure arrived at was 500 to 600 volts, and this was admitted to be safe, and enabled the electricians to instal their systems at a reasonable and possible cost, while it was not dangerous to life under ordinary circumstances. What the electricians did was this—they had several points along the line where electricity was imparted to it at a proper pressure—sub-stations, they might call them—to which feeders went. Where they had got that simple problem of generating electricity at one place and sending it to another, and there delivering electricity at any required pressure, what they did was this: they sent it at a terrific pressure through conductors fixed in an absolutely safe position to the place where they wanted to put it into the line, and there they changed the tension. Such was the safety of the system that they could use a pressure of 12,000 to 15,000 volts. There, again, the practice of electricians was uniform, and it worked admirably. They did not make this transformation by means of continuous current, but it was done by what was known as the three-phase current—that was, an alternating current in each of three wires. Those alternating currents were just as easy to generate as the continuous current, and the pressure could be changed simply by a stationary piece of apparatus—they changed it into a direct current by means of a converter. So the system adopted universally, when the size and complexity of the traffic required it, was this: They generated the three-phase current, sent it at high pressure to various points along the track through which they intended to distribute their electricity, and they dropped it at a stationary transformer to alter the pressure; it then passed through a rotary transformer and appeared as a direct current from 500 to 600 volts in pressure, which worked the whole machinery. The great advantage of the system was this: All their troubles of complexity of high pressure and alternating current and everything of that kind were on the generating side, and the current, so far as the traffic was concerned, was easily manageable—in other words, the whole of their complexities were outside the traffic arrangements. There were two main considerations which they must keep before them. The first, of course, was safety, and the other was certainty of uninterrupted traffic. Inasmuch as it had been found that this system was easily manageable as well as safe, it had extended very rapidly everywhere, and was, he might say, universally adopted. The result had been that electrical ingenuity had been turned for years to solve the various problems which arose in the use of this system, and both with regard to converters and the question of control all difficulties had been practically overcome. All this past experience, demonstrating the certainty with which electrical traffic could be worked, made his clients advise their shareholders to make this change, but then they met with difficulty on the part of the Metropolitan Railway, who jointly owned part of the lines on the Inner Circle. The result was that Parliament said it should be decided by an arbitrator what should be the system adopted on the Inner Circle. The Metropolitan Railway wanted the Ganz system, the fundamental difference of which system was that instead of turning current into a continuous current of from 500 to 600 volts, it got it in the three-phase state at a pressure of 3,000 volts and used it in the cars. He put it to the arbitrator that by that system the Metropolitan Railway would take all their complexities and dangers to the traffic part of their system, whereas by the generally adopted system the District Railway would have nothing to do with that. There was not a single mile of railway at the present moment working according to the Ganz system, nor had there ever been. He did not need it to be thought that he took the attitude that there were no new discoveries to be made in electricity, but everything in the Ganz system had been before the eyes of electricians, and had not been used during all those 12 or 15 years. Putting aside the question of pressure for a moment and looking to the use of the three-phase system only, there had certainly been some experience in Switzerland, where it had been used up to 750 volts. But there was not a single characteristic to be found in those cases which made a comparison with the Metropolitan Railway possible. Quite apart from the question whether or not ultimately they might not be able to use this three-phase current for the system, he said that it would be perfect madness to introduce a system bristling with the most difficult problems for the sake of some supposed saving which was not only problematical, but which, he believed, would not turn out to be the case. He ventured to say that the Ganz system was scientifically and practically condemned. First, with regard to safety. Two of the wires would have to go along the top of the tunnel, and the clearance between the cars and the top of the tunnel was exceedingly small. There were also the iron girders of the tunnel to be considered, and it was along the top of that tunnel they would have to carry wires which were highly charged, and they would have to keep them always at such a tension that they did not sag, and to see that there was no leakage. Anything more dangerous for use in a tunnel like that he could not conceive, and, what was more, he could not see how it was going to be installed without stopping the traffic, which would be disastrous. The system of control suggested by this system was absolutely different to that which was now in such enormous practical use, and which had been found to give no trouble at all. Practically, it took the control out of the hands of the driver. It gave the train an acceleration for a certain number of seconds beyond the driver's control; it changed the condition without his helping it. It controlled the braking so much that so far as he could see they could not make up time. The Italian Government had given the fitting up of a railway, 67 miles in length, to the company, but it had not been opened, and as it was to be water power, no comparison as to economy could be made. But from the measurements made that was found to be impracticable for the Inner Circle. With regard to cost, he failed to see that it would be more economical, for the conductors would have to be made large enough to carry 40 per cent. of useless current. As to the history of the tenders, the engi-

neers never seemed to have realised that Messrs. Ganz's tender was not comparable with the others, because it was not a tender for the same thing—it was a tender for a pressure which had never been allowed. It was only when his clients looked closely into the thing that they found out the facts, and he might say that the tender passed without criticism in the first place by reason of its very audacity. In conclusion, he said that prudence and responsibility urged them to stick to that which had been tried and had been found to be universally successful, and which had now been reduced to a system which could be supplied without anxiety and risk. His clients felt it would be calamitous if they were compelled to take part in a system over part of the line which they felt to be quite untried, and the difficulties and problems of which had never been practically faced.

Mr. Perks, M.P., chairman of the Metropolitan District Railway Company, was then called, and explained the District system, and also gave the traffic figures of both the District and the Metropolitan Railways. He said that he and his friends were very large shareholders in the District Company, in fact, they subscribed the whole of the stock of the Ealing and Harrow line, which was now ready for opening, and the whole of the stock for the Whitechapel and Bow line of the District. The late chairman, Mr. J. S. Forbes, used to confer with him (Mr. Perks) as to the best methods of raising the necessary capital for converting the District Railway from steam to electric traction. At that time he was in communication with American friends, the principal of whom was Mr. Yerkes, and he consulted with him upon the subject. He had confidence in Mr. Yerkes because he knew what he had done, and that he was a man of very wide experience indeed. The result was that he advised Mr. Forbes to follow the advice of Mr. Yerkes and his friends in the adoption of the general system of electrical traction in use on the Central London Railway, the Metropolitan Railway at Paris, the Brooklyn Railway in New York, the New York Rapid Transit Railway, the whole of the Chicago Railways, &c. He might state that, unofficially, Col. Mellor and the Metropolitan Railway were thoroughly aware of all that went on, and they knew that he and his friends were not in favour of the untried system of Messrs. Ganz. Asked to give his opinion of the two systems, witness said he had obtained information from some of the most practical engineers in the world, who were not purely theorists, but men who had actually converted railways from steam or cable to electrical traction, and he found that nearly everyone of them was in favour of Yerkes's system, on the grounds of economy, safety, and practical working. He was convinced that they dare not try the Ganz experiment on their railway. He would let other people make experiments of the system if they cared to. The question was one that pressed for settlement, for he might say that they were losing about £1,500 a week by the delay in adopting electric traction, and the Metropolitan Company was losing more. He had no interests whatever, from a pecuniary point of view, in the Traction Company—his interests were solely those of the District Railway. They had decided to adopt the ordinary system on all the company's branch lines.

Cross-examined by Mr. Cripps, Witness said that up to a certain point Sir W. Preece represented the District Company. That gentleman was now in favour of the Ganz system, but that was not the opinion of the shareholders and the directors of the District Railway. Apart altogether from the American interest, he and his friends were powerful enough to stop the introduction of the Ganz system on to the line. He was informed that his American friends had not a penny interest, as manufacturers, in the Ganz system.

The inquiry was adjourned till the following morning.

(To be continued.)

LEGAL.

De Ferranti *v.* The British Thomson-Houston Company, Limited.

In the Chancery Division of the High Court of Justice on October 25th, before Mr. Justice Cozens-Hardy, Mr. Fletcher Moulton, K.C., in this Birmingham case, asked that the action might not come into the list for hearing before November 11th. The learned counsel stated that the action was an important one, and had reference to patents for electrical meters. Before the case would be ready for trial, consultations must take place between experts, and the convenience of both sides would be met if a short postponement were granted.

Mr. Justice Cozens-Hardy acceded to the application.

Johnstone, Benjamin & Co.

The affairs of Messrs. Johnstone, Benjamin & Co., 10, Ascham Street, Leverton Street, Kentish Town, manufacturers of electric wires and cables, came before Mr. Justice Wright, sitting on Monday as Bankruptcy Judge in the King's Bench Division.

Mr. Muir Mackenzie said he appeared with Mr. Whately for the trustees under the firm's bankruptcy proceedings in support of a motion to declare the assignment by the debtors of substantially the whole of their assets to a limited company as void. The trustees, however, had had an offer made by the respondents to pay to them a sum sufficient to defray all the costs and charges of the bankruptcy, to pay the preferential debts in full, and a composition of 10s. in the £ to the other creditors on all provable debts. The trustees considered those terms excellent for the creditors, but thought it right to call his Lordship's attention to the fact that a scheme of arrangement in identical terms to the offer now made had been laid before the Registrar in Bankruptcy. The Official Receiver on that occasion reported adversely upon it on the ground that the transfer of their business by the debtors to the company was void. The Registrar accordingly adjourned consideration of the scheme until that point had been decided by his Lordship by means of this motion. The trustees were anxious, for the benefit of the creditors' pockets, to accept the terms offered, but thought they ought not to do so without first acquainting the Court of all the facts. In reply to his Lordship, Mr. Muir Mackenzie said the arrangement had been unanimously accepted by the creditors, and the Official Receiver had reported that it was calculated to benefit them, because it was possible that under an administration in bankruptcy the estate would not yield a dividend of 10s. in the £. The only bar to the Court's sanction had been the report that the transfer of the business was void as against the trustees. The trustees regarded the application as one to affirm the transfer to the company in consideration of handing over the agreed amount for the benefit of the creditors.

Mr. Carrington, on behalf of the respondents, said the validity of the transfer of the business to the company had not yet been investigated, but he had a mass of evidence to show that it was a *bonâ fide* transaction.

His Lordship observed that he would be taking upon himself a great burden if he set aside the views of the creditors and trustees. He thought the arrangement ought to be sanctioned so far as the Court was called upon to sanction it, but he would say nothing to decide any matter of the debtor's conduct, which would have to be dealt with later by the Bankruptcy Registrar.

The motion was accordingly settled on the terms arranged between the parties.

British Motor Traction Company, Limited, *v.* Moore.

Mr. Walter appeared before Mr. Justice Farwell on Saturday, and moved for judgment in the above action. He stated that the motion was brought on in default of appearance, and the action was one to restrain the defendant from infringing certain patents belonging to the plaintiff company. He asked the Court to grant perpetual injunction against the defendant from using those letters patent, and to direct that an inquiry be made as to damages.

His Lordship made the order asked for, and allowed the plaintiffs taxed costs.

C. A. Church (H. Conolly & Co.).

A motion was brought before Mr. Justice Wright, sitting on Monday last as Bankruptcy Judge in the King's Bench Division, arising out of the failure of Charles Alfred Church, manufacturing electrical engineer, trading as Henry Conolly & Co., at 42, Hampstead Road, and elsewhere. The debtor failed last June with total liabilities £12,334, and assets valued at sufficient to provide a surplus of £4,557 after payment of all debts. The motion was launched by the trustee against Mrs. Church (the debtor's wife) and a certain firm of auctioneers, for an order to hand over the lease of the premises, 42, Hampstead Road, stated to have been given to Mrs. Church by the debtor to secure loans amounting to £500, and transferred by that lady to the auctioneers to hold as a lien for charges of £100 they had against the debtor for work done on his behalf.

Upon the case being called, Counsel for the trustee stated that it was unnecessary to proceed as Mrs. Church had given an authority to the auctioneers to hand over the lease to the trustee. Evidence in support of that statement having been taken,

His Lordship made an order in the terms of the notice of motion, and directed the costs of the auctioneers and trustee to be paid out of the estate.

Pole *v.* Alabaster and Another.

In the King's Bench Division at the High Court of Justice on Tuesday, this action came on for trial before Mr. Justice Ridley and a special jury. The plaintiff, Mr. Benjamin Charles Pole, an engineer, sued Mr. H. Alabaster and Mr. T. E. Gatehouse, the proprietors and publishers of the Electrical Review, to recover damages for alleged libel contained in the issue of that paper of March 30th, 1900. The defendants denied that the words were defamatory, or that they were written of and concerning the plaintiff, and pleaded that the article was fair comment upon a matter of public interest, written and published *bonâ fide* and without malice, and for the benefit of the public.

Sir Edward Clarke, K.C., and Mr. Whateley were counsel for the plaintiff; Mr. Rufus Isaacs, K.C., Mr. F. Dodd, and Mr. J. C. Graham appeared for the defendants.

Sir Edward Clarke said the action was brought in respect of an article published by the defendants, who were the proprietors and publishers of the Electrical Review. This article was not only a criticism which would have been perfectly fair upon scientific matters so far as the plaintiff had connected himself with engineering inventions, but was an unfounded and unjustifiable attack on the plaintiff personally. It was in that aspect of the case that it would demand the jury's serious consideration. The plaintiff had been for many years engaged in engineering works

in America, and two or three years ago came to this country with a view of exhibiting the "multiple energizing momentum engine," with regard to which he used the word "Poleforcia" as expressing a power he said he could get in excess of the power obtainable by other machinery used for similar purposes. The idea of the plaintiff's engine was that there were five fly-wheels of very large dimensions and great weight, operated each by a separate engine, and these wheels were, from time to time, by an automatic process, attached to or detached from the driving shaft from which the power was to be obtained. The plaintiff's idea was that a heavy wheel, if set in motion, acquired a very great momentum, which, when acquired, was attached to the driving shaft, and did work while the other engines were released and were acquiring momentum, which, from time to time, was applied to the driving shaft by the attaching of the fly-wheels to that shaft. His (plaintiff's) theory was that the momentum which was acquired by the rapid revolution of these very heavy wheels secured a greater power to the driving shaft than could be secured by the direct action of the ordinary engine. "Poleforcia" was the word he used to express this increase of power or accelerating force. The plaintiff described his invention in papers full of technical phrases, one of which came before the conductors of the ELECTRICAL REVIEW. In his (Sir Edward Clarke's) view it was not necessary to discuss whether the plaintiff's engine was a good or a bad one, because he thought the jury would say the article contained accusations which would prevent a fair consideration of the invention under consideration, and would attach a certain stigma and reproach to the plaintiff when he came before the public or engineers to deal with it. The article was as follows:—

"**Poleforcia.**—Every few years sees the recrudescence of the idea of something for nothing. We do not say that the new force of poleforcia belongs to this category, because it is impossible to tell from the extraordinary jargon of a very lengthy pamphlet which treats of the subject just what it is that the writer is trying to describe. The 13 pages of this extraordinary production are written in the English as she is spoke style of, we should imagine this time, a German. It is decidedly funny. Here is one characteristic paragraph:—'In consequence of the revolutions of this shaft, levers are forced up and held up together, then those levers which were up, when the two new levers are forced up, these first two are dropped, leaving two still forced up.' This is clearness itself compared with other passages. In plain English, if we understand the drift of the invention, the 'multiple energising momentum engine,' whose headquarters are at 130, Westminster Bridge Road, consists of a series of engines with ratchet coupling to an assemblage of fly-wheels, and some wonderful gain of energy is supposed to be secured by the non-positive connection in the performance of 'rotary foot-pound work.' Each fly-wheel is run nine revolutions idle, and then is coupled automatically to the shaft for three revolutions. The idea in the inventor's mind appears to be that he in some way gets hold of energy from nothing, because more power is required to lift 1 ton 1 ft. than to draw 1 ton 1 ft. horizontally. This is to him 'the spirit of a living thing in the wheels.' Evidently Ezekiel has been getting at him. It must have cost a lot to print the brochure on very good paper, and there must be some deluded creature at the back finding the money for this ridiculous thing. Presumably the public may be asked to subscribe to this, or we should not have noticed the affair at all. If those in it are acting in ignorance, it is kindness to let them know their engine is best fitted for the useless scrap heap."

The learned counsel submitted that the article suggested that the plaintiff had imposed upon some deluded person by the pretence that he had got a good thing, that its object was to warn people against the plaintiff in respect of this alleged invention, and that the defendants having refused to insert an apology in their paper, the plaintiff was entitled to some compensation for the injury that libel would do him if it were not contradicted in public.

Mr. BENJAMIN CHARLES POLE, the plaintiff, was then called, and in the course of his examination, said that many years ago he conceived the idea which he ultimately developed under the name of "Poleforcia." He had spent thousands of pounds in developing his idea, and now had an engine working the electric light at the Alexandra Palace. In his opinion the invention was a very useful one. There was no foundation for the suggestion that he had deluded anybody; on the contrary, he had spent his own resources, and experimented in an open shop where everybody could see his engine and take their tests.

Cross-examined by Mr. RUFUS ISAACS: "Poleforcia" is the name you give to the new power which you say you invented?—To the developed power made by my engine.

Does your engine create this power?—My engine brings it about by a series of momentums as I use them.

It is referred to by you as a new power?—A new way of turning a shaft.

Do you object to my calling it a new power?—It is a new power the way I use it. I have arranged a new power.

Is it your contention that you get out of your engine a greater output than the input?—If you describe the input and output, we do; if you do not describe them, the mere use of the words does not mean anything.

Do you pretend that by your engine you get more output than input of power?—When the input is calculated and the output is calculated.

Do you now state that your engine will produce a greater output in foot poundage of power than the input?—Yes.

I suppose if you can do that, it would not be an exaggeration to say that you have discovered something which is worth a hundred times more than the discovery of perpetual motion?—I do not think the turning of a wheel is of any value by itself. The wheel I turn is a useful wheel, turning a very large dynamo.

In further cross-examination, WITNESS was asked if he thought he could get more power out of a grindstone than he put in, and he replied that a grindstone was a single unit, and he did not make that claim. Asked the same question with regard to two grindstones coupled, the witness said he could not answer "Yes" or "No." The new power he claimed to have invented was a means of storing energy plus acceleration. Witness proceeded to say that he had not attempted to turn his invention to account in England, but he was attempting to work it commercially in the United States, though no orders were taken for engines. "Poleforcia" was in the experimental stage, but tests in America had demonstrated that it saved coal. An application was made by the defendants to test the machine running at the Alexandra Palace with a view of finding the result as regarded input and output of power. The engine was not ready, so tests were made with a smaller one he had at the Aquarium. The tests were made in the presence of a number of scientific gentlemen, and the result was that the output of energy was considerably less (about one-half) than the input. The tests were perfectly fair, and he had no recollection of making any complaint to the gentlemen who were testing. A wheel of larger diameter would have been better for his engine. He and the proprietors and editors of the ELECTRICAL REVIEW were unknown to each other. The pamphlet on which the comments of the defendants were based was sent out for advertisement—to get people to put money into "Poleforcia," and use it when they thoroughly understood it. The pamphlet was sent out inviting comment. In his opinion it was wrong to prevent money going into the investigation of "Poleforcia."

In re-examination, WITNESS said that if the article had been confined to scientific formula and saying his invention was worthless, he would not have brought the action.

This was the case for the plaintiff.

Mr. RUFUS ISAACS, K.C., addressing the jury for the defence, said the plaintiff's invention had no commercial value, and he had claimed to do that which was in fundamental opposition to all the principles of science, and which was nothing more nor less than an absolute absurdity. The plaintiff was one of those mistaken people who became possessed of an idea that they had hit upon some wonderful thing, and were convinced that they had invented something which would revolutionise the whole world, and which was the most marvellous invention which had ever been brought to light in the history of science. If the plaintiff had done what he claimed to do, people would be going down on their knees to him for leave to use his invention. This machine was examined by the defendants and their experts at the Aquarium, and it was shown that it did not do what the plaintiff claimed it did. What the plaintiff claimed was to get more out of an engine than he put into it—a thing which could not be done by human agency. He submitted that what the defendants had written was in the nature, therefore, of fair comment.

Mr. W. WORBY BEAUMONT said it was absolutely impossible there should be any gain of power by means of the plaintiff's engine. The device of the fly-wheels and clutches meant an extra loss of power. This device had been known for 50 years, and there was nothing new in the patent of the plaintiff. The effect of the change was to put energy into the fly-wheel at one moment and take it out the next. That was all the philosophy there was in it.

Prof. PERRY, F.R.S., agreed with the evidence of the previous witness. He added that in the first set of tests there was 1·4 electrical power put into the plaintiff's contrivance and ·425 came out—that was to say, 70 per cent. of the power was lost in the machine. In the second set of tests 67 per cent. was lost. It was not conceivable that there should be an exception to the fundamental principle of modern engineering, which was that you could not get more energy out of a machine than you put into it by any contrivance whatever. The pamphlet on "Poleforcia" was very like the documents put forward by men who invented such things as perpetual motion, and who deceived themselves and used scientific jargon.

Mr. W. H. BOOTH, a member of the American Society of Civil Engineers and an engineer of 30 years' experience, said he was the author of the article in the ELECTRICAL REVIEW. When he wrote it he did not know such a man as Mr. Pole existed. Until he saw the pamphlet he had never heard of "Poleforcia." There were passages in the pamphlet which were sheer jargon to an engineer. The article was written *bonâ fide* and without malice.

Mr. T. E. GATEHOUSE, one of the editors of the ELECTRICAL REVIEW, said that the article in question came under his supervision before it was printed. He first heard the name of Mr. Pole when he received the solicitor's letter. He read the pamphlet on which the article was based. The claim the plaintiff made was a physical impossibility.

In cross-examination by Sir EDWARD CLARKE, WITNESS said Mr. Booth was an old and valued contributor to the paper, and he was satisfied of that gentleman's *bonâ fides*. It was clear, from the pamphlet, that the plaintiff pretended to get three times as much out of his machine as was possible.

Mr. C. W. S. CRAWLEY and Mr. E. C. DE SEGUNDO, also gave evidence.

COUNSEL addressed the Court.

Mr. Justice RIDLEY, in the course of summing up, said the question for the jury was whether the article was to be treated as a libel or as a fair criticism on a matter of public interest. In his opinion the pamphlet did claim that the plaintiff had discovered a new power, and that he was getting more out of his engine than he put into it. If the jury came to the conclusion that the pamphlet claimed for the plaintiff's engine that which was impossible, they would also come to the conclusion that the bulk of the article was not stronger than the plaintiff deserved.

After considering the matter for 20 minutes the jury returned a verdict for the defendants.

Judgment was given for the defendants accordingly, with the costs of the trial and of the tests which had been made by order of the Court.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending Oct. 30th, 1900.		Week ending Oct. 29th, 1901.	
Adelaide	Value £2,087	Adelaide	Value £118
Amsterdam	85	Bilbao	100
Bombay	75	Bombay	85
Buenos Ayres. Teleg. mat. ..	150	,, Teleg. wire	855
Calcutta	1,803	Boulogne	82
Cape Town	472	Buenos Ayres	231
Christiania. Teleg. wire ..	44	,, ,, Teleg. mat. ..	510
Colombo	446	Calcutta	935
Copenhagen	15	Cape Town. Teleg. mat. ..	900
,, Teleg. wire ..	17	Colombo	42
Durban	279	Copenhagen. Teleg. cable ..	67
,, Teleg. mat.	87	Durban	577
Gothenburg. Teleg. wire ..	16	East London	498
Hamburg. Teleg. mat.	550	,, Teleg. poles ..	139
Melbourne	1,005	Fremantle	50
,, Teleg. wire.. ..	1,016	Halifax	10
Ostend	203	Hobart	47
Perth	200	Karachi	10
Piræus. Teleg. apparatus ..	100	Launceston..	109
Rio Janeiro	176	Melbourne	673
,, Teleg. mat. ..	185	Nagasaki	170
St. Petersburg	10	Penang	824
Santiago	25	Port Elizabeth	64
Shanghai	215	Rangoon	1,303
,, Teleg. cables, &c. ..	2,090	Rotterdam	65
Singapore	287	St. Petersburg	243
,, Teleg. cable	147	Singapore	299
Stockholm. Teleg. mat. ..	65	Stockholm	26
Sydney	2,083	,, Teleg. cable.. ..	564
,, Teleg. & teleph. goods, &c.	5,100	Sydney	1,447
Tokio	505	Tokio	29
Yokohama	769	Trinidad	20
,, Teleg. cable ..	8,793	Valparaiso	10
		Wellington	121
		,, Elec. instruments	1,043
		,, ,, Teleph. mat. ..	925
		Yokohama	283
Total ..	£23,600	Total ..	£12,774

Foreign Goods Transhipped.

Perth. Elec. goods	Value £1,011	Bombay. Electrolyser ..	Value 278
Stockholm. Elec. goods ..	35		
Total	£1,046	Total	£278

Automatic Block Signals for Electric Railways.—The first application of automatic block signals for electric railways was that installed on the Liverpool Overhead line in 1893. Recently they have been adopted on the whole system of the Boston Elevated Railway. The signals are operated on the Westinghouse electro-pneumatic principle, and probably no other example is to be found in which the value of automatic block signals for the expediting of train movements is more pronounced. The train service on this line is so frequent that each signal is operated at least 600 times a day. The signals work on the "normally clear" principle. This, with a frequent train service, is by far the best arrangement, since, were the signals worked on the "normally danger" principle, the frequency of the trains would practically convert it into a "normally clear" one. The Westinghouse electro-pneumatic system is rapidly gaining favour in this country. Quite recently the North-Eastern Railway Company have ordered a 106-lever equipment for their station at Tyne Dock. The system is about to be placed in use in the large station now being built at Bolton by the Lancashire and Yorkshire Railway Company, and it is well known that the Great Eastern Railway Company have had in continuous use for two years past at their Whitechapel Goods Yards a similar equipment.

Bankruptcy Proceedings.—The last day for receiving proofs in *re* W. R. Beckton, Herne Hill and Holborn, is November 9th. Trustee, Mr. E. L. Hough, Carey Street.

November 8th is the latest date for receiving proofs in *re* J. A. M. Collier, electrical engineer, Gateshead. Trustee, Mr. J. Gibson, 30, Mosley Street, Newcastle.

Liquidations.—Creditors of the Edwards Electrical Company must send particulars of debts, &c., to A. E. Darville, 19—21, Queen Victoria Street, E.C., the liquidator, by December 1st.

A petition for winding up the Electrical Regulating and Lighting Syndicate (presented by Mr. J. E. Stott, electrical engineer, of Birmingham) is to be heard at Manchester on November 11th.

A meeting of the Universal Electrical Advertising Syndicate is to be held at Nottingham on November 29th to hear an account of the winding up from the liquidator, Mr. T. G. Mellors.

Books Received.—"Electrical Catechism," by Geo. D. Shepardson. New York: *American Electrician* Company. 1901. $2.

"Scientific Research," by Stephen Smith, M.R.C.S. Second edition. London: Elliot Stock. 2s.

"Practical Electric Railway Handbook," by Albert B. Herrick. New York: Street Railway Publishing Company. $3.00.

"The Cyanide Process of Gold Extraction," by James Park. London: Charles Griffin & Co. 1901. 7s. 6d.

"Science Abstracts," October 25th, 1901. London: E. & F. N. Spon, Limited. 2s.

New Edition.—An entirely new edition of Dr. Mullineux Walmsley's "Electricity in the Service of Man" is being issued by Cassell & Co. in 6d. parts. See our advertisement pages this week.

Catalogues and Lists.—From the Newton Electrical Works, Limited, we have received a circular of the windmill driven self-regulating dynamo which they built for the Antarctic expedition ss. *Discovery*, which has already been referred to in the columns of the Electrical Review.

Some cards of "Atlas" patent portable machine tools have come to hand from the Atlas Engineering Company, of Levenshulme, who make a speciality of electrically-driven tools. The illustrations show horizontal boring machine, portable electric radial drill (Mather & Platt's patent), and other tools at work inside a 21 ft. ring.

Messrs. L. M. Ericsson & Co., Limited, of Temple Chambers, E.C., send us a copy of their new priced catalogue, Section "D," in which their intercommunication telephones and accessories are illustrated and described. Examples of estimates and diagrams showing connections are included.

Marconi's Wireless Telegraph Company, Limited, sends us an illustrated list of its 10-in. induction coils, which are manufactured at the company's works. The company has specialised in induction coil making.

The Tandem Smelting Syndicate, Limited, sends us a priced circular of a "regenerative" alloy for purifying and making up stereo and type metals.

A well got up pamphlet has been issued by the Typewriting Telegraph Corporation, of Dashwood House, E.C., describing their Steljes' patent type-printing telegraph apparatus. A list of people to whom the apparatus has been supplied is given.

Controlling the Speed of Electric Cars.—Messrs. Estler Bros., of Laurence Pountney Hill, E.C., are introducing to the market an automatic governor for controlling the speed of tram cars. The apparatus is designed to automatically actuate a switch or resistance when any predetermined speed is attained, so that the speed of a car or other vehicle can be controlled and kept within any desired limit. The device is specially applicable for governing the speed of tramcars in order to comply with the Board of Trade regulations, and, we are informed, can now be successfully applied for this purpose. It is a somewhat difficult matter to lay down a hard and fast rule respecting the maximum permissible speed allowed, and expect a motorman or driver to strictly adhere to that rule under all circumstances. With this automatic device fitted to a car it is claimed to be impossible to exceed the B. of Trade limit, as the moment this is attempted the automatic switch opens and promptly cuts off all power from the motors. The general arrangement applied to cars is as follows:—A sprocket wheel is fitted to the axle of car which drives a countershaft attached to bearer of car body. This shaft is driven by either a chain or steel cord, and drives a small pulley underneath the platform of car where a pair of bevel wheels are enclosed in an oil-tight box and geared to speed indicator. This indicator is calibrated to read "Miles per hour," and is fixed in a position so that the driver can see at all times the speed at which the car is travelling. It is fitted with a pair of contacts that may be set for the pointer of a tachometer to close the circuit of a four-volt battery when any predetermined speed is attained. The automatic switch is fitted with a solenoid and trip gear, so that immediately the car exceeds the maximum permissible speed, electrical continuity from the battery is established, and the circuit breaker on the car opens and cuts off all current from the trolley wire to the motors. The apparatus can be made so that when the speed is reduced to, say, three miles an hour, the circuit breaker is automatically closed again. This, however, introduces a complication which is not desirable. It is much better for the motorman to do this after convincing himself that his controller is on the "off" position. The above is a description of the apparatus in its simplest form, and it is considered that it ought to meet the demands of the B. of T., and be a valuable guide to a driver even when "coasting" downhill. In districts where steep inclines are numerous, and, possibly, a source of danger, the apparatus in its simplest form would not be adequate as an automatic arrangement, because normally, when coasting, the current is already cut off at the controller. The apparatus should preferably be available to act automatically even under these conditions. To meet this demand another apparatus covered by letters patent has been devised. This apparatus consists of a circuit breaker provided with a trip gear as described above, but is so arranged that when the main current circuit is broken, due to excessive speed, certain other contacts are made such that current is supplied to the electric brakes and the car direct from the trolley wire, stopping the car quickly. This takes place even if the controller is on the "off" position, *e.g.*, when descending an incline. Generally, on whatever position the controller handle may be, when the excess speed is acquired, the apparatus puts on the electric brakes, and cuts off all current from the motors. Thus the speed is automatically controlled, whether the car is running on the level, or "coasting," with current off. The public is protected from possible danger caused by excessive speed, and the tramway company from claims due to accidents, which are generally easily proved and based on fast driving. The driver is also released from fines, as he cannot drive beyond a predetermined speed fixed by the B. of T. As the "rushing" of cars is done principally at night, by simply connecting one series of lamps to the underside of the automatic switch, not only the passengers, but also the public, can see at a glance when the driver has exceeded his speed, as the moment the main switch opens, one half of the lamps in the car are auto-

matically switched off, and remain so until the offending member puts the switch on again. The apparatus may be used for a number of other purposes, *e.g.*, to prevent the racing of marine engines, to regulate feed water of boilers, the temperature of buildings, stores, &c., the output of dynamos and motors—in fact, for any purpose where accurate regulation is necessary.

Dispute.—The *Liverpool Post* states that a dispute, which might have developed into a serious and disastrous strike, at the works of Messrs. Laird Bros., Birkenhead, has now been settled amicably by arbitration, the difference being between two trades, namely, the engineers and shipwrights, as to to whom belonged the work of securing the electric dynamo on board ship, both sides claiming that the character of the workmanship was such as to bring it within the special scope of their particular trade. By mutual consent the dispute was referred to two arbitrators, Sir Fortescue Flannery, M.P., acting at the request of the Amalgamated Society of Engineers. As the result, the court of arbitration has awarded that the engineers shall take charge of the work and have the responsibility for the proper placing and adjustment of the dynamos, and it is expected that the work in question, which alone, in the vast operations of the yard, had been suspended pending the taking of evidence and consideration of the arbitrators' award, will now be amicably resumed.

Electrical Contractors' Association.—A meeting of delegates representing the Local Associations from Newcastle-on-Tyne, Leeds and district, Hartlepool, Sunderland, Darlington, Stockton and Teesside was held at the County Hotel, Newcastle-on-Tyne, on Saturday afternoon, the 26th ult. Reports and notes from the respective secretaries were read and discussed. A strong feeling was shown that a Northern section subservient to the National Contractors' Association should be formed for more active combination, and the following resolution was unanimously carried:—

That a sectional Association comprising the North of England, embraced by the districts of Berwick and Carlisle on the north, and Hull, Sheffield and Manchester and district on the south, be formed with the object of easier organisation and combination for mutual interests of the respective Local Associations in their district, and that a further meeting be convened for this purpose at an early date.

A meeting is to be held in Leeds on Saturday, November 23rd. Secretaries of Associations desiring to be represented should communicate with Mr. Claude Johnson, Westminster Chambers, East Parade, Leeds, secretary of the Leeds Masters' Association.

Metallic Gasket.—We have received samples of the Merwarth metallic gasket, an American device, which is being introduced into this country by the Fairbanks Company, of 16, Great Eastern Street, E.C. This consists of a soft metal ring, about $\frac{1}{4}$ in. in diameter, reinforced by an outer copper ring $\frac{1}{16}$ in. in diameter; to the latter are soldered two short copper wires, which are bent round a couple of the bolts to hold the gasket in place. When the flanges of the pipes are drawn together by screwing up the nuts, the soft metal is squeezed up, filling all inequalities and ensuring a steam-tight joint, for which great durability is claimed. Further, the gasket can be used again after opening the joint, and it is applicable to any size or type of joint; such gaskets are in use up to 60 in. in diameter for cylinder covers, &c., with satisfactory results. In these days of high pressures and superheated steam, leaky joints are too often met with in central stations, and a reliable packing, such as this appears to be, should come as a boon and a blessing to engineers.

Siegrist Lubrication.—The Manhattan Railway Company has given a contract to the Siegrist Lubricator Company, of St. Louis, Mo., to instal its system of automatic lubrication for the entire power plant of 96,000 H.P. The Siegrist system is also being installed by the De Beers Consolidated Diamond Mines Company, of Kimberley, South Africa, and at the Glasgow Tramway Power Station, the largest plant in Great Britain.

Siemens's New Works.—The *Stafford Advertiser* says that considerable progress has already been made with the extensive new works which Messrs. Siemens Brothers, Limited, are erecting in the Lichfield Road. The contract for the earthwork, which was let to Mr. Godwin, of Hanley, and the contract for the sidings, which was let to Mr. C. J. Nevitt, of Stafford, have almost been completed, and the contract for a portion of the brickwork and general building has just been let to Mr. H. Lovatt, of Wolverhampton and London. The pool by the Queensville Bridge has been doubled in size and considerably deepened, and this will be used as a cooling pond. Mr. Lovatt's contract amounts to £10,000, and comprises a building some 500 ft. long by 50 ft. wide, which will be used as the erecting and testing shop. Other buildings for which the contracts have not yet been let will comprise the machine shop, the wood-working shop, and sawmills. It is hoped that the works may be completed in about 18 months.

Sutton and Howth Tramways.—In our description of the Sutton and Howth electrical tramway in our issue for October 18th, we omitted to mention that the main switchboard was constructed by the General Electric Company (1900), Limited, who acted as sub-contractors in this respect to Messrs. Ernest Scott and Mountain.

For Sale.—The Grand Theatre, Swansea, is offering certain electrical plant for sale.

Trade Announcements.—The British Thomson-Houston Company, Limited, electrical engineers and contractors, who have recently moved their head office to their works at Rugby, will on November 1st move their showrooms from their present quarters at 26 & 27, Bush Lane, to 83, Cannon Street.

Mr. A. K. Baylor announces that he has removed to Oxford Court, Cannon Street, E.C.

What the British Consuls have to Say.—*Electricity in Norway.*—Vice-Consul Thiis (Fredrikstad) reports that the extension of the Aktieselskabet Hafslunds electric power station at the Port of Sarpsborg will, when finished, enable the company to dispose of over 16,000 H.P., and if required, the station can be still further increased by 7,000 to 8,000 H.P. The town is now furnished throughout with electric light, the necessary current being supplied by the company referred to. Electrical works are being built on account of the town of Flekkefjord, the power—about 1,000 H.P.—being taken from a waterfall situated about 7 miles from the town. The charge for light in Flekkefjord is at the rate of 10s. per 16-normal-light lamp; for manufacturing use the charge is £2 15s. to £3 18s. per H.P. per year, the rate being lower the more power is required, this rate working out much cheaper than the use of steam. The flour mills at Skien, Vice-Consul Franklin states, are lighted by electricity. The Skien Electric Power and Light Works, the British Vice-Consul thinks, are worthy of mention. He states that they are driven by water-power, having six dynamos, &c., delivered by the firm of Schuckert, of Nüremberg, the town being lighted from the works. Porsgrund is also erecting electric works, the dynamos being supplied by Siemens & Halske, of Berlin, both the firms mentioned having branches in Norway. The Gjenisó Kloster, Skien, is reported to be the seat of several new industrial undertakings mostly worked by water-power or electricity. The mechanical and electrical works at Skien, with a capital of about £20,000, have passed into the possession of a German firm, W. Lahmeyer, of Frankfort-on-Main. The works utilise 120 H.P., and employ about 100 men in the manufacture of dynamos, &c.

San José Electric Tramway.—This tramway, which was built and is worked by the Costa Rica Electric Light and Traction Company, a British undertaking, runs from the railway station in San José to the end of the Sabana, a distance of about 3½ miles, and, according to the report of Consul Harrison, is well patronised. During the dry season, however, the cars do not run after 5.30 p.m., as, owing to the lowness of the rivers, there is not sufficient power to enable the company to run the trams and furnish light at the same time. An extension of the line to the Mojón and Curridabat is contemplated, and the rails have been laid for a distance of two miles, but, Consul Harrison states, owing to disputes with the Telephone Company the work has been suspended. He understands that it is also proposed to make use of water-power some miles from San José, so that the company may not continue to be subjected to the difficulties experienced during the last two dry seasons.

Waterworks and Electric Lighting in Malta.—The cost of the electric lighting and waterworks in Malta during 1900 is returned at £29,924 3s. 6½d., an increase of £4,008 16s. 10½d. on the expenditure in 1899, this increase being attributed to higher salaries and wages in the electric lighting department, rise in the price of coal and of materials in general, and part cost of a new surface condenser.

Telephones in Malta.—All Government departments, charitable institutions, and the principal police stations in Malta are connected with the "Melita Telephone Exchange," which is a private enterprise. Communication with the island of Gozo is now carried on by telephone under the management of the military authorities.

Electricity v. Coal.—Consul C. C. Morgan, in his report on the general trade of Italy for the year 1900, has occasion to direct attention to the falling off in the British coal trade with Italy, which is largely due to the fact that Italy is trying to utilise its combustibles, and the circumstance that electric power obtained from its numerous waterfalls is being extensively resorted to. He is afraid that the falling off will be more marked in future, partly on account of possible American competition, and the only way of counterbalancing the deficiency in the coal imports, so far as he can see, is by pushing the trade in electric machinery. Up to the present, he states, Italy's workshops are such as not to be able to meet the increasing demands for electric plant, and he believes that there is an opening for a fairly large trade in that direction.

Electric Furnaces for Producing Acetylene.—The various companies formed in Italy for the manufacture of acetylene, Consul Morgan states, now own 30 electric furnaces for the production of calcium carbide, chiefly in the neighbourhood of the waterfalls of Terni and Narni, in the Perugia districts.

The Trade of the Faroe Islands.—Consul Villiers is of opinion that this would probably develop more rapidly if there were better facilities for communication with the islands. There is no cable to the Faroe Islands, and no telegraphic wires there even, and during the winter several weeks usually pass without a mail boat either leaving or arriving.

Swedish Electrical Enterprise.—Cheap and good telephones, Consul MacGregor states, are plentiful in Sweden itself, and as an instance of Swedish enterprise abroad he mentions that on November 20th, 1900, a concession was granted by the Russian authorities to a Swedish company for the construction of telephone lines in Moscow and Warsaw, the rights to extend over a period of 18 years. In order to carry out the undertaking, the Swedish company associated itself with other Swedish and some Danish capitalists. It is estimated that subscribers will have to pay about £7 10s. in Warsaw and £8 7s. in Moscow.

ELECTRIC LIGHT AND POWER NOTES.

Accrington.—The T.C. contemplates the establishment of a special installation for the market stalls, and has instructed the town clerk to apply to the L.G.B. for the necessary borrowing powers. The Corporation proposes to undertake the wiring of consumers' premises, on terms which provide for the repayment of the money expended in five or seven years.

Albury.—The question of the electric lighting of the district has been before the Parish Council for several years, and the Duke of Northumberland has agreed to lease a stream on his estate. Mr. A. A. Campbell Swinton has presented a voluminous report on the whole subject, and states that even if all the available water-power were utilised, not more than 500 16-c.p. lamps could be provided for at one time, compared with an estimated total of 1,407 lamps required. The difficulty, however, could be met by the use of storage batteries and running the dynamos continuously. The estimates for the work are as follows:—

Two 15-H.P. dynamos, with mill gearing	£337
Main cable to chief battery station	832
Battery for 1,000 lights, with switchboard and instruments..	941
Service mains and public lamp connections	1,545
Underground conduits..	1,645
Contingencies	547
Total	£6,023

Mr. Swinton estimated that the revenue at 6d. per unit would be £865. The matter will be discussed at the next meeting of the Parish Council.

Bangor.—Colonel W. Langton Coke last week held a L.G.B. inquiry into applications by the Corporation for sanction to borrow sums of £2,032 and £4,500 for electric lighting purposes. The amount authorised to be spent on the construction of works, purchase of land, &c., was £15,900. The number of 8-c.p. lamps now connected was 6,200, and when the Council received permission to borrow the £4,500 asked for, they would be able to supply 12,000 8-c.p. lamps. There was no opposition to either of the applications.

Barnes.—An experiment is about to be made in this district in lighting the streets with 700 Nernst lamps.

Birkenhead.—The T.C. has decided to apply to Parliament for powers authorising the Corporation to supply and deal in electric fittings, and to make arrangements with consumers for assistance in wiring.

Bloemfontein.—At a recent meeting of the T.C. the Public Works Committee reported that it was impossible to supply more light to private consumers until the transformers on order had arrived. Authority was obtained for the purchase of additional meters.

Bristol.—There has been an increase this year over the figures of 12 months ago of no less than 33,573 lamps of 8 c.p. This is by far the greatest increase that has taken place in any year since the commencement of the undertaking. In fact, the average increase for the last three years has been equal to what was at the outset thought sufficient for the whole city—viz., 20,000 lamps. The revenue in 1900 was £37,398. The use of electricity for power is also gaining ground.

Burntisland.—The new dock is being lighted with arc lamps by Messrs. Crompton & Co., Limited. The whole area of the quays will be lighted, with 39 lamps.

Calcutta.—The following letter written by Messrs. Kilburn & Co. (the managing agents for the Calcutta Electric Supply Company), and appearing in the *Indian Daily News* for October 4th, explains trouble which has arisen in connection with the Calcutta supply mains:—"We think that an explanation is due to the public in respect to the interruptions in the supply of current which have occurred during the last few weeks, and which we fear have caused great discomfort and inconvenience. Most of the Calcutta Electric Supply Corporation's mains have been laid underground on one of the most approved systems in use in England, and under the direct superintendence of the most experienced cable makers that England affords, and there is no doubt that under English conditions the results would have been excellent. The system, however, has not proved itself impervious to injury from the peculiar climatic conditions of Calcutta. The directors are fully alive to the importance of the matter, and are taking vigorous steps for the rectification of those points where weakness has been disclosed. The system has stood well during the dry season, but developed weakness towards the close of the rainy seasons both this year and last. Before next rains we expect that the whole system will have been overhauled and made secure against further mishaps. As a first step in this direction automatic cut-outs have been obtained, which will automatically disconnect any defective main in case of accident, and so prevent a stoppage of supply, as the other mains will remain in connection. We are now waiting for the permission of the municipality to erect the pillars for these cut-outs, which we trust will shortly be granted."

Colwyn Bay.—A L.G.B. inquiry takes place to-day into the application of the D.C. for sanction to borrow £8,450 for electric lighting.

Coventry.—The T.C. has adopted the recommendations of the E.L. Committee, which we outlined in our last issue.

Enfield.—The D.C. has requested Mr. R. Hammond to advise upon the agreement submitted by the North Metropolitan Electrical Power Distribution Company, Limited, and the proposals of the Provincial Electric Light and Traction Company, Limited.

Exeter.—The City Council, which, on October 14th, received a committee's recommendation for acceptance of the British Westinghouse Company's tender of £29,707 for equipping the new electricity generating station, is sharply divided on the subject, chiefly on the question of engines, one section being in favour of reciprocating, and the other of turbine engines. Messrs. Parsons had tendered for the equipment of the works for £27,981 2s. The Council met again to consider the matter. Councillor Bradley Rowe said he did not know that Messrs. Parsons had ever entirely equipped a new station, and it would be a risk to put the whole job into their hands. Besides, turbines were still in the experimental stage. Councillor J. A. Loram said Parsons engines were being put in in some places in substitution for reciprocating engines. Blackpool and Sheffield were quite satisfied with turbines in their generating stations, and, at any rate, the Government did not consider turbines as experimental. Councillor Berry said 94 per cent. of electric stations in the United Kingdom were fitted with reciprocating engines, and in the majority of instances in which turbines were being added it was on account of limitations of space. Of the 75 electric tramways in the kingdom 72 used reciprocating engines, and two had those engines supplemented by turbines, only one being run entirely by turbines. Councillor Munro's amendment was put to the meeting—"That, subject to the contractor agreeing to a substantial increase in the amount of fine or bonus for deviation from the specification in steam consumption, and agreeing to the machinery being tested on the site by an expert appointed by the Council, the offer of Messrs. Parsons be accepted, the contractor to guarantee the efficiency of the whole of the work for 12 months after completion; and that the Committee be empowered, if they think fit, to substitute surface for ejector condensers." On a division this was defeated by 28 to 20. Councillor Challice thereupon moved a second amendment: "That, in accordance with the advice of Mr. Hammond, the specifications be re-drafted and tenders invited from the Westinghouse Company, Messrs. Parsons, and Messrs. Ferranti, on the basis of the new specifications." After a 3½ hours' debate, the subject was adjourned until Tuesday night, and at that meeting was, without discussion, further adjourned to next Tuesday.

Germany.—The establishment of municipal electricity works in the town of Plathe has been decided upon.

Glasgow.—A gas explosion in a manhole occurred in Hillhead last week, extinguishing the lamps in the Western district for some hours.

Heywood.—On Saturday last the new electricity works, which have been erected at Hind Hill for the Corporation, were opened by Alderman Maden, ex-Mayor of the borough, and chairman of the Electric Lighting Committee. The works and the laying of the electric mains have cost about £14,000. Mr. Adams was the consulting engineer.

Kilmalcolm.—Negotiations have been entered into with the Clyde Valley Electric Power Company for the introduction of the electric light into Kilmalcolm.

Lancaster.—The T.C. has decided that the price of energy for motors be reduced to 3d. per unit.

Liverpool.—The Electric Lighting and Power Committee has included in the Parliamentary powers, which the Council are about to apply for, a provision that a person shall not be entitled to demand or to continue to receive from the Corporation a supply of electrical energy to premises having a separate supply, except on terms which will afford the Corporation a reasonable return upon the capital expenditure involved.

Leatherhead.—The U.D.C. notifies in the *London Gazette* its intention to transfer its provisional order to the Leatherhead District Supply Company.

London.—Camberwell.—The Borough Council intends to exercise its powers of purchase over the London Electric Supply Corporation's undertaking, and to take up the supply of electricity itself.

City.—The Streets Committee, reporting upon the subject of the contracts with the City of London E.L. Company, has recommended a further adjournment of the question till February next.

Westminster.—The City Council has resolved to support the L.C.C. in obtaining powers to better control the breaking-up of the streets by the water, gas, electric light, and other companies.

Maritzburg.—The Borough Council decided to spend £120,000 on electric lighting, but was unable to make up its mind whether the lighting scheme should or should not be submitted to an expert. The result of a plebiscite of the ratepayers is that an expert will be brought from England to superintend the plans for the lighting programme.

Monmouth.—The Town Council has fixed the charge for electrical energy for motors, used in the daytime only, at 3d. per unit.

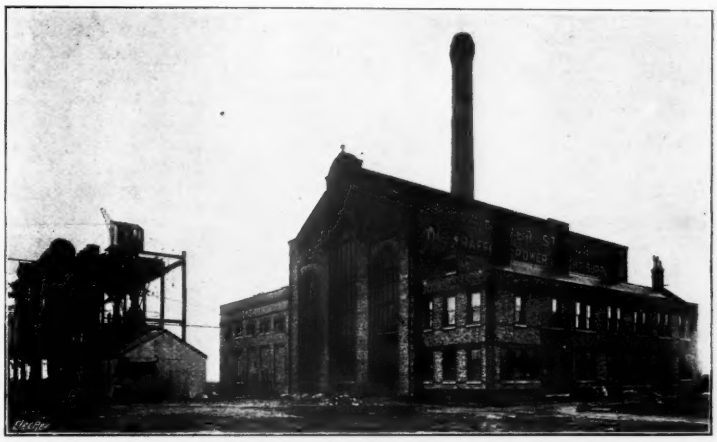
St. Helens.—After many appeals, the Electric Supply and Tramways Committee has offered the St. Helens Tramways Co. an annual rebate of £3 for each private consumer who uses the cables which were laid down for the purposes of the tramways system.

(*Continued on page* 719.)

TRAFFORD PARK POWER SYSTEM.

The Trafford Power and Light Supply, Limited, was formed to work a concession granted in perpetuity to Mr. W. P. J. Fawcus, M.I.C.E., for the exclusive right of supplying electric power, light, and fuel gas in Trafford Park, Manchester.

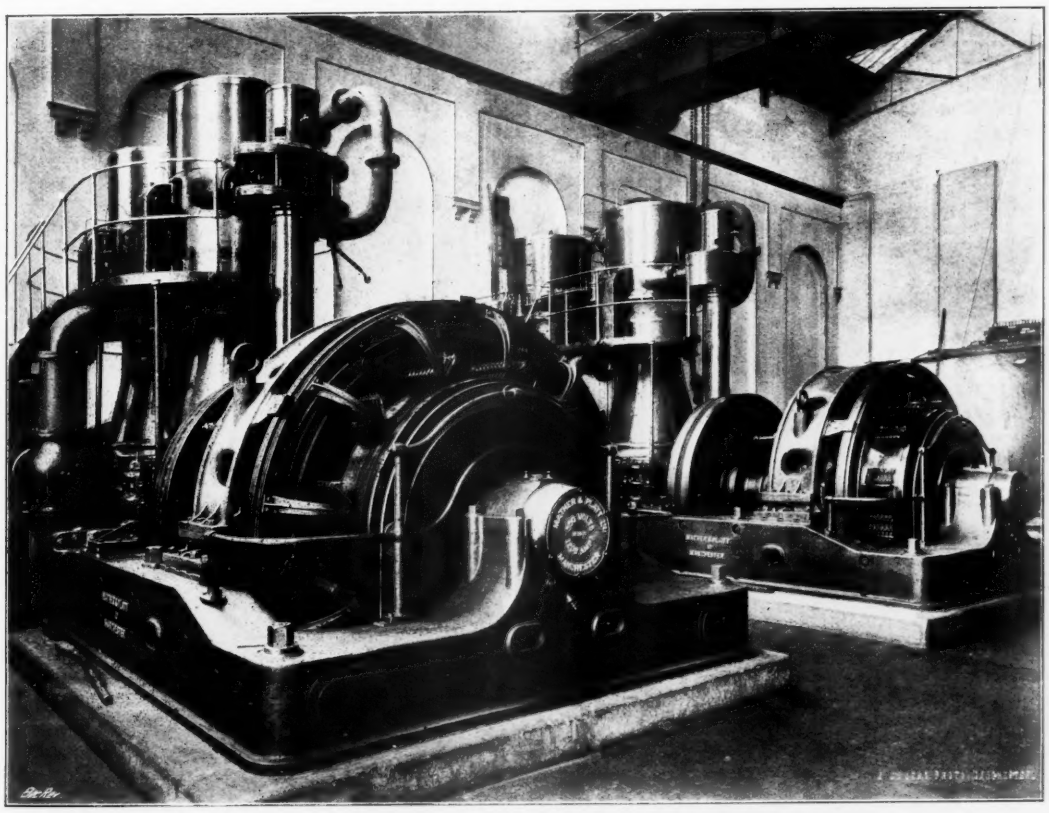
The Park, which was formerly the property of Sir Humphrey de Trafford, was acquired by the Trafford Park Estates, Limited, and has been developed by them for industrial purposes. It is practically an island, bounded on the north by the Manchester Ship Canal, and on the south by the Bridgewater Canal, and about 3 miles long by 1½ miles broad at the widest part.



Trafford Park: Exterior of Power Station, showing Gas Plant.

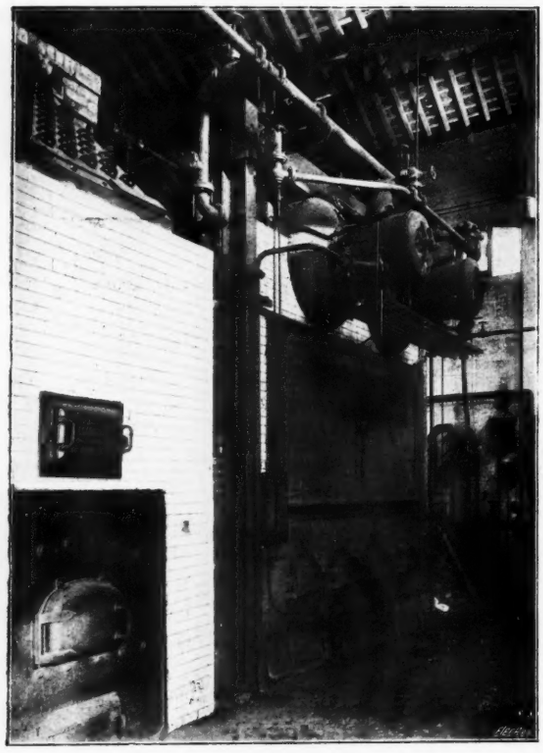
electrical is represented by the following firms, all of whom are being supplied, or are to be supplied, with current by this company, and some also with fuel gas :—The British Westinghouse Company ; W. T. Glover & Co., Limited ; The Lancashire Dynamo and Motor Company, Limited ; The British Electric Car Works ; Messrs. Royce, Limited; and The Howard Conduit Company, Limited.

Other industries are maltings, lead pipe works, patent fuel works, lard refining works, saw-mills, corn mills, stone polishing works, brick works, contractors' workshops, foundries and engineering works, warehouses, &c. In addition to power which the company supply to factories in the Park, and the lighting of the whole of the workmen's



Trafford Park: Generating Plant

The industrial development of this estate has been very rapid ; already a large number of factories and workmen's dwellings have been erected, and more are in course of building. Amongst a great variety of trades established, the dwellings throughout, together with the shops, streets, and public roads, outside their own area, they have arranged to supply the docks and warehouses of the Manchester Ship Canal Company, and the Urban District of Sale. It will



Trafford Park: Part of Boiler House.

be seen, therefore, that the prospects of obtaining an abnormally high load factor are considerable, and it may here be stated that during the first eight months of this year the load factor varied between 70 and 55 per cent.

Having thus briefly outlined the *raison d'être* and scope of the company, we will proceed to a general description of the power house and the plant installed. A general exterior view of the buildings is shown on page 715, and we will not add to the impression there conveyed beyond remarking that a good design has been capitally executed. Mr. Joseph Nodal, architect and engineer, of Manchester, is responsible for the design, and Messrs. William Southern and Sons, of Salford, for the execution of the plans.

System of Supply.—The following briefly outlines the system laid down by the company:—

Direct current generators, assisted by motor-driven balancers, supply the local area by means of a three-wire 500—250-volt network. The longer feeders will, however, be supplied with high pressure alternating current, generated by three-phase alternators.

During the development of the area it has been found unnecessary to instal alternating plant, but the further machinery now on order is designed to generate alternating as well as continuous current.

As the load increases and the need for longer feeders arises, motor-generators will be installed at the feeding points, which will supply the network with low pressure direct current, and will be driven by the three-phase current. It will thus be seen that the alternating current is primarily intended for generation and transmission purposes solely, and not for distribution.

The cables at present in use are therefore of low-pressure quality, insulated with impregnated paper. They were supplied and laid by Messrs. W. T. Glover & Co., Limited. The draw-in system, using Doulton earthenware ducts and "Howard" bitumen conduits, has been adopted, since the replacement of lengths of cable by others of greater section is by this means rendered comparatively simple.

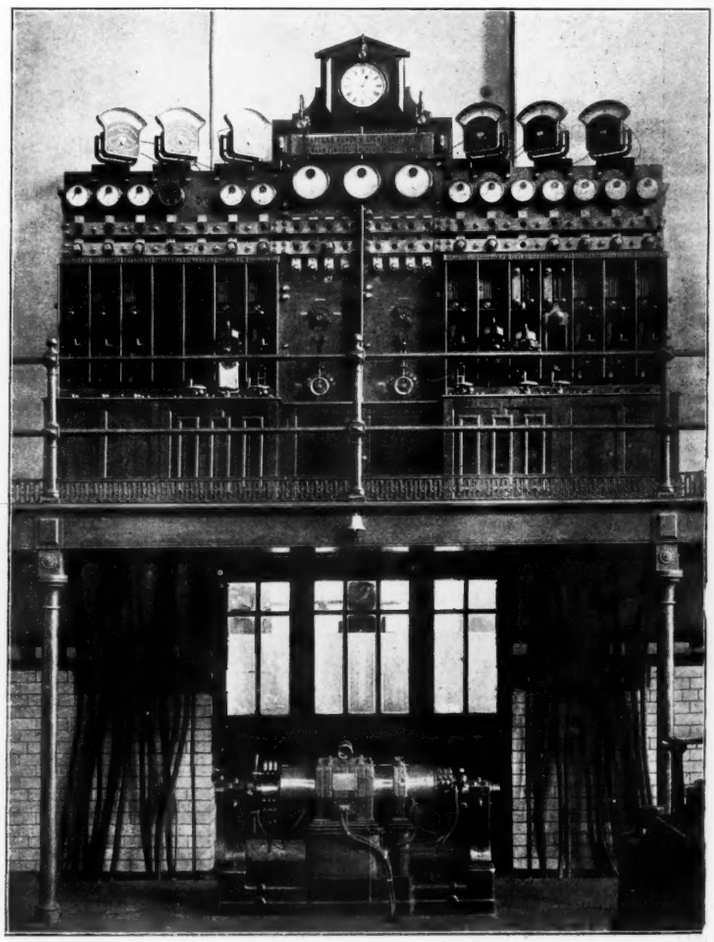
Boiler House.—The steam-raising plant at present consists of three boilers, all of the water-tube type. Two of these were supplied by Messrs. Babcock & Wilcox, the other being due to Messrs. Tinkers, of Hyde. The latter involves several new features of construction, but has not yet been under steam sufficiently long to justify a criticism of its performance.

Each boiler was primarily designed to be fired by "Mond" gas, a plant for the production of which is now in course of erection adjacent to the boiler house, and on the bank of the Bridgewater Canal.

The firing floor consists of wrought-iron chequered plates, which are supported on light steel cross-girders. This floor also constitutes the roof of a cavity about 6 ft. in depth. In this cavity the main pipe, of 39 in. internal diameter, for the delivery of the gas to the boilers, is fixed. Horizontal tee connections, about 12 in. in diameter, are made to each boiler and superheater combustion chamber, and a regulating valve on this connection enables the fireman to admit the exact quantity of gas required to meet the varying demand on the boilers.

The combustion chambers are several feet below the ordinary grate level, and are so designed as to ensure the complete combustion of the gases before they come into contact with the boiler tubes. The admission of air is arranged for by specially designed grids.

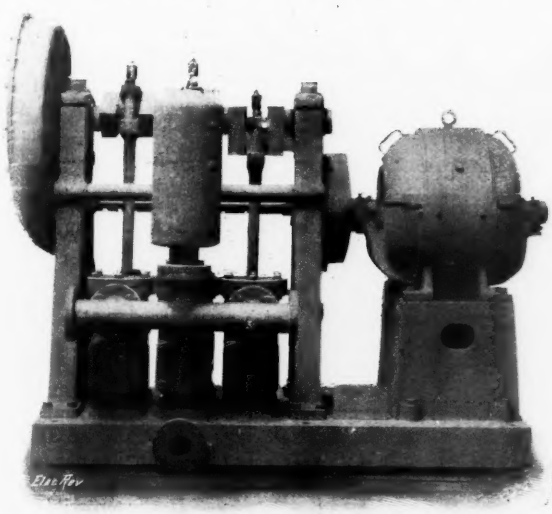
It will be seen that, apart from all other considerations, the company have, by the adoption of gas firing, practically



Trafford Park: Main Switchboard, and Balancer.

insured themselves against the waste and nuisance of black smoke.

Pending the completion of the gas plant, now a matter of



Trafford Park: Electrical Feed Pump.

eeks only, the Babcock boilers have en fitted with temporary fire bars, on hich coal and coke are burnt as in rdinary furnaces. These bars can be adily removed when gas firing is mmenced.

Alongside each boiler is a Schmidt perheater, but these have not yet been in use, the original design having been abandoned at the eleventh hour. The eam pipe connections are such as to dmit of any superheater being connected or disconnected at will.

The chimney is of circular section, built of brick, and is of very handsome exterior appearance. The height from the boiler house floor level is 135 ft. and the internal diameter 6 ft. at the top.

In the main flue is a Green's economiser of 192 tubes, each tube being 9 ft. long by about 4½ in. diameter. It is constructed in two sections, each of 12 rows, eight tubes wide. The scrapers are operated continuously by a 1 H.P. "Lundell" motor geared direct by means of a worm and wheel through automatic reversing gear. Incidentally, we may here remark on this motor's excellent behaviour, the maintenance being practically *nil* beyond the renewal of carbon brushes due to wear and tear.

Messrs. Royce, Limited, of Manchester, supplied the boiler feed pumps, which are arranged in duplicate, and are of the vertical three-throw type, each capable of delivering 3,000 gallons of water per hour against a steam pressure of 150 lbs. per square inch.

These pumps are electrically-driven by electric motors through double reduction gearing—the motor shafts being fitted with raw hide pinions, which engage with cast-iron spur wheels. All the gearing is completely enclosed, and runs very silently, being always immersed in oil. The general arrangement is good—each set presenting a very compact appearance, as may be gathered from the illustration.

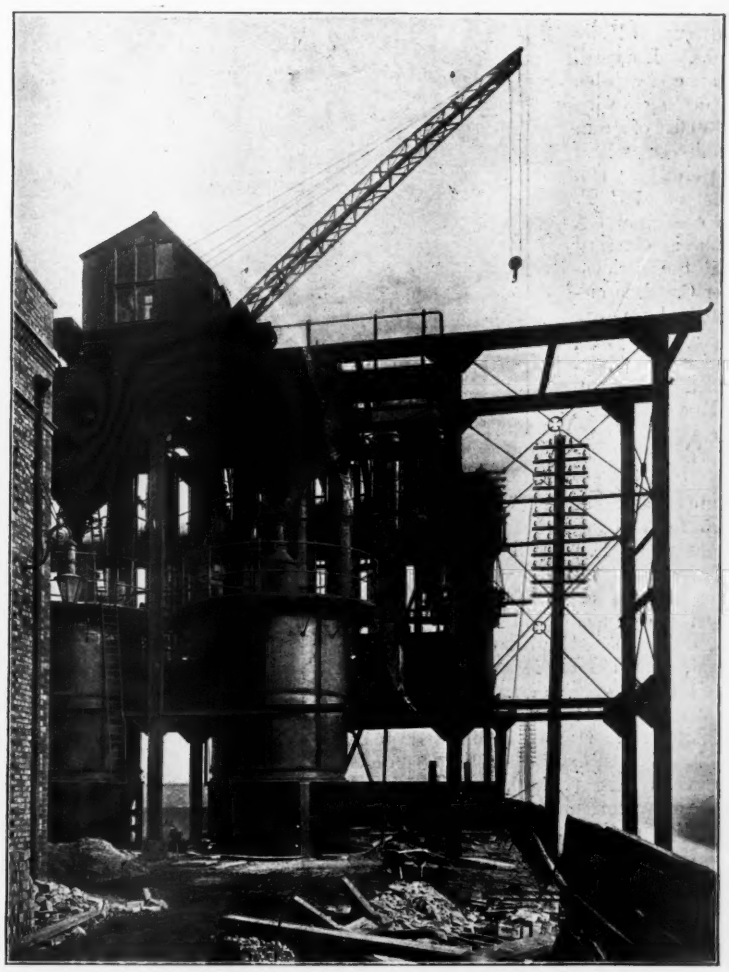
Each motor has a double-wound armature, and is fitted with two commutators, so as to admit of the series-parallel method of control being used. By the adoption of this method the efficiency at low speeds is much improved, and a very wide range of speed variation is possible without undue waste in armature resistances. The controllers, supplied by the same makers, are fixed on the firing floor level in line with the boiler front, and enable the attendant to regulate the feed perfectly; this is proved by the fact that the feed pumps are never stopped, once the boilers are under steam.

Engine Room.—On entering the engine room one is immediately struck by the very ample amount of head room. The lighting both by daylight and electricity has been well attended to, and the result is very effective.

Mounted on gantries running the full length of the engine room is the hand-operated overhead travelling crane, which was supplied and erected by Messrs. Craven Bros., of Manchester, and is capable of lifting up to 25 tons.

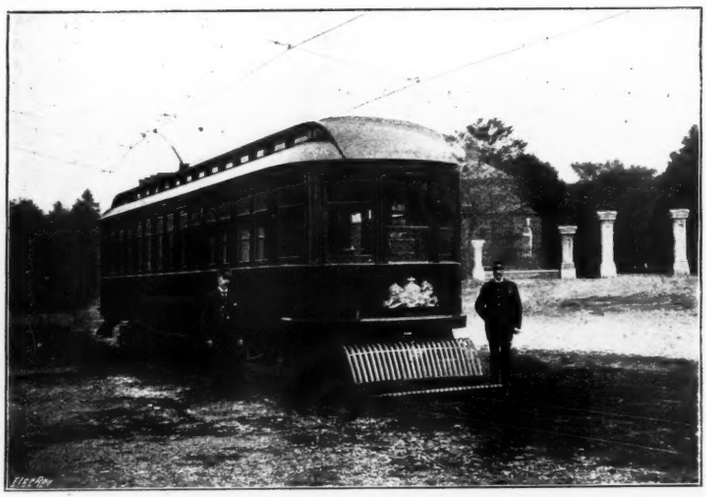
The generating plant at present in use consists of two sets, each of 1,000 H.P., while a third of equal capacity is in course of erection. Each of the existing sets consists of a vertical steam engine coupled direct to a multipolar continuous-current dynamo by means of a heavy cast-iron fly-wheel, which is fixed on to an extension of the crank shaft. The general appearance of the set is shown in our view on a previous page.

Each engine is virtually composed of two 500-H.P. units of the well-known Raworth Universal type, having two cylinders in tandem, and with their connecting rods coupled to a common crankshaft at 180° apart.



Trafford Park: Mond Gas Plant.

The lubrication is arranged for by means of a separate rotary oil pump, driven by a "Renolds" chain from a toothed wheel fixed on the end of the crankshaft outside the governor, which is of the crankshaft type.



Royal Tour: Special Trolley Car.

The condensers are of the ejector type, with exhaust inlet at the top, and the water inlet at the side, the discharge being from the bottom. They were supplied by Messrs. Ledward, and are each capable of dealing with 16,000 lbs. of steam per hour when supplied with water at 70° F. The cooling water, which is obtained from the Bridgewater Canal, is circulated by means of a Gwynne centrifugal pump, coupled direct to a Royce motor, each pump having a normal duty of 425 gallons per minute to a height of 25 ft., and an increased duty of 675 gallons to 30 ft. The head is varied by changing the motor speed, effected by means of a pillar controller.

Of the dynamos nothing need be said beyond the fact that they are compound-wound, and are of Messrs. Mather and Platt's usual solid construction, the commutators particularly calling for comment in this respect. Each dynamo has 12 poles, and has an output of 1,200 amperes at 550 volts when running at a speed of 200 revolutions per minute, with its engine supplied with steam of 150 lbs. pressure at the stop valve. The armatures are slot wound, and are fitted with equalising connections.

The balancers, two in number, are of the bipolar type, and were supplied by the E.C.C., Limited, of Wolverhampton. Each machine consists of a double-wound armature, one winding on either side of the middle wire. The field is shunt excited, and the regulation is effected by means of an auxiliary pair of magnets, round which the current in the middle wire circulates before reaching the armatures. Either machine is capable of dealing with an unbalanced current of 200 amperes. One balancer is shown in the switchboard view.

The main switchboard, erected on a gallery in such a position as to command a view of the whole engine room, was supplied and erected by Messrs. Cowans, Limited, of Salford, Manchester, to the specification of the consulting engineers. A view is given on an earlier page which will suffice to show its principal features. Messrs. Cowans have made all parts particularly heavy — a point illustrated by the fact that all the main switches are designed to carry 1,500 amperes. The company contemplate immediate extensive alterations and additions to the board, which are necessitated by the enormously increased demand, the feeder accommodation being now quite inadequate.

On the engine room floor level is the distributing board, which controls all the motor and lighting circuits in and about the station. This board is built away from the wall, and it is thus possible to instal temporary instruments in the circuit of any motor by mounting them behind the board, where all the circuit wires are readily accessible. This enables a constant check to be kept on the current consumption of any motor which may give rise to suspicion by either overheating or sparking. This board was manufactured and erected by Messrs. Royce, Limited.

Royal Tour: Interior of Car.

Gas Plant.—One of our views shows the general arrangement of the plant for the production of the "Mond" gas. This consists of a steel structure about 80 ft. high, and is built in such a way as to make extensions a comparatively simple matter.

Royal Tour: Illumination of Parliament Buildings, Ottawa.

At the top, on rails running the entire length of the structure, is to be seen the travelling jib crane, which was supplied and erected by the makers, Messrs. Royce, Limited. The duty of this crane is to raise the coal by means of special boxes from the barge alongside to the various hoppers, clearly shown in the view. It is electrically-driven by means of two motors—one for hoisting and slewing, the other for travelling motions. The following particulars may be of interest :—

Full load, 2½ tons; hoisting speed, 50 ft. per minute; slewing speed, 150 ft. per minute (taken at the end of the jib at full radius); travelling speed, 80 ft. per minute; clear lift, 75 ft.; centres of rails, 12 ft. 8 in.

The jib swings to a radius of 26 ft., and this may be varied to 18 ft. by means of a derricking motion which is operated by hand. The hoisting mechanism is so designed that a load equivalent to the maximum (2½ tons) plus 25 per cent., would be refused, owing to the lifting gear being operated through the makers' patent friction drive. The counterbalance is such that there is no tendency to canting or tilting with a load equivalent to double the maximum.

(*To be concluded.*)

THE ROYAL CAR "DUCHESS OF CORNWALL AND YORK."

By the courtesy of the President of the Ottawa Electric Railway Company, Mr. T. Ahearn, we are enabled to give views and a description of the special tramcar which was provided by the company for the use of T.R.H. the Duke and Duchess of Cornwall and York during their recent visit to Canada. We understand that the car was particularly pleasing to the Duke and Duchess, and has excited much favourable comment in Canada and the States.

The car is 50 ft. in length, with straight sides, vestibuled at both ends, and having a full monitor roof of the Pullman pattern. The colour is also of the Pullman standard, with the British coat-of-arms in gold, conspicuous on both front and rear. The interior of the car is finished in antique polished oak, the ceiling being covered with three-ply bird's eye maple veneer, and decorated. There are four large British plate mirrors set in frames, two at either end of the car. All trimmings, such as hat racks, hooks, &c., are of solid bronze. The window curtains are of the latest design, of very ornamental pattern. The floor is covered with a rich, royal blue velvet carpet. The car contains 14 large easy chairs, beautifully upholstered in olive green plush. The car is brilliantly illuminated by five clusters of incandescent electric lamps, 21 in all. The trucks are double, and of the swing motion pattern, with graduated springs. The electric equipment is very complete and powerful, consisting of four Westinghouse 50-H.P. motors. The car is also fitted with the Westinghouse automatic air brake, and is capable of attaining a speed of 50 miles per hour.

This is the first electric tramcar ever provided exclusively for the use of Royalty; it was manufactured by the Ottawa Car Manufacturing Company, for the Ottawa Street Railway Company.

Another of our illustrations shows the electrical illumination of the Parliament Building, which was the finest display of the kind ever attempted in Canada. The Departmental Buildings were also illuminated, but do not appear in the figure.

It is interesting to observe that Ottawa, with a population of 60,000 people, has a greater electrical development than any other city of equal population in the world, having over 100,000 16-C.P. lamps installed, and 45 miles of tramway track in its electric railway system. The residents are naturally proud of their position in this respect, in view of the fact that none of the cities of equal population in the United States can approach these figures.

When the Duke and Duchess of York and their distinguished party visited Canada, they tarried at Niagara-on-the-Lake, Ont., over Sunday, October 13th, and from that point, at the mouth of the Niagara river, went up to view the Falls of Niagara on Sunday afternoon. At Niagara-on-the-Lake they boarded the magnificent steamer *Corona* of the Niagara Navigation Company's line, and were taken up the river to Queenston; there they were met by Hon. W. Caryl Ely, president of the International Navigation Company, and escorted to his beautiful private car, which they boarded, and were soon in the enjoyment of the splendour of the autumnal glories of the Niagara gorge. The day was beautiful, and the colouring of the foliage was never seen to better advantage. Mr. Ely pointed out the interesting features of the wonderful river, and when they reached the whirlpool rapids elevator, Canadian side, the party descended to the water's edge. From the rapids Mr. Ely escorted them to the Falls, where all enjoyed the sublimity of the great waterfalls.

ELECTRIC LIGHT AND POWER NOTES.

(*Continued from page* 714.)

Surbiton.—A meeting of ratepayers has passed a resolution strongly adverse to the proposed electricity scheme of the D.C.

Swindon.—On October 23rd Mr. Meade-King, L.G.B. inspector, held an inquiry anent the application of the T.C. for sanction to borrow £31,000 for the purpose of electric lighting. The town is at present supplied with gas by two local companies. At a meeting of the T.C. held subsequently, Mr. A. J. Colbourne's tender of £5,174 1s. for the erection of electricity works and buildings was accepted.

Tiverton.—The T.C. has considered proposals for the electric lighting of the town by means of water-power. A suitable site had been offered to the Council for £2,100, but Alderman Amory opposed the scheme, and laid its cost at £18,650, against the £11,000 estimated by Mr. Adams, one of the Council's advisers. Alderman Winton favoured a request being made to the B. of T. to extend the Council's provisional order for five years, in order that, *in the meantime, the Council could make more profits out of their gas-works!* An amendment that the experts, Messrs. Nell & Adams, be asked to reconsider their figures, in comparison with those of Alderman Amory, was passed.

Walthamstow.—The D.C. is ordering an additional dynamo and engine for the electricity works.

Wimbledon.—The U.D.C. has decided to apply for a further loan of £14,448 to complete the electric lighting scheme, in consequence of the increasing demand for current. Subject to the approval of the Croydon R.D.C., the Wimbledon authority has entered into an agreement to supply current for lighting purposes to the Merton Parish Council, the charges to be the same as those obtaining in Wimbledon.

Woolwich.—The M.B.C. have sealed their contracts with the Woolwich District Electric Lighting Company for the purchase of their undertaking, and for the supply of energy pending completion. The War Office has been informed that the Council will supply current to the various barracks at 3½d. per unit for the first 100,000, 3¼d. per unit for the next 100,000, and 3¼d. for additional units per annum.

Worksop.—At a meeting of the D.C. on Monday, additional machinery for the electrical works was ordered to be purchased at a cost of £282, and 24 meters at £3 13s. 9d. each.

ELECTRIC TRACTION NOTES.

Aberdare.—The Glamorgan County Council are contemplating applying for powers to construct a light railway from Aberdare to Bridgend, a portion of the proposed line being in the area of the Rhondda District Council.

Batley.—The B. of T. has given permission to the Corporation to serve a notice upon the Dewsbury, Batley and Birstall Tramway Company requiring them to sell to that authority such part of their undertaking as is within the borough. A fortnight ago the shareholders of the company accepted the offer of the British Electric Traction Company to purchase the whole of their undertaking, and this giving of power to the Batley Corporation seriously disturbs that arrangement.

Beckenham.—There is a good deal of opposition here to the idea of tramways, and the matter is to be discussed at a special meeting on Monday.

Bexley.—At their last meeting the Urban Council definitely engaged Messrs. Mordey & Dawbarn as consulting engineers and advisers in the work of installing the electric tramways and lighting.

Black Country.—The B.E.T. Co. have under consideration tenders for the extension of their tramway service in the Black Country. They include provision for the making of tramways through Bilston to Moxley; and also through Ettingshall and Brudley to join the main road between Bilston and Moxley. Another section contemplated is one from the Bilston Road along Stow Heath Road to Moseley Village and on to Willenhall. From the latter town there will be two separate lines, one to Bilston and another to Darlaston. The work will be proceeded with the moment the tenders have been decided upon.

Bury.—A town's meeting was called for Tuesday to consider the Corporation tramway scheme. A report published by the Tramways Committee states that the lengths of the proposed tramways are 11 miles 0 75 chains, equal to 16¾ miles of single line. The whole of the present rails will be taken up and new rails of a heavier section used. The estimated cost is as follows:—Permanent way, 25 cars, and car depôt, £112,500; electrical equipment, £30,000; street improvements, acquiring property, making good of carriage ways, &c., purchase of present tramways, &c., £61,500; total, £204,000. The total annual payment for sinking fund and interest is put down at £9,639. The annual expenditure is estimated at £26,514. The receipts are estimated at 600,000 car-miles per annum at 1s. per car-mile, £30,000.

Durban.—The Town Council have decided to order two electric street-watering trams.

Dublin.—James Lyons was charged before the Dublin Police Magistrate on Saturday last with having maliciously injured portions of the electric tramline between Dublin and Lucan. A constable saw him hammering at the track, and found he had removed one of the copper bolts used on the line. The manager proved that upwards of 100 of these bolts had been taken during the month, and had the weather been dry, traffic would have been stopped altogether. Lyons got two months with hard labour.

Dublin to Slane Electric Railway.—An influential meeting was held in Dublin on Thursday last week for the purpose of completing the provisional committee nominated for the scheme for the construction of an electric railway between Dublin and Slane (Co. Meath). Mr. M'Andrew explained the engineering aspect of the project. According to his calculations, the line starting from Smithfield (Dublin) would be nearly 28 miles long. Of this distance, at least three miles must be laid flush with the road, which would cost £7,000 a mile. The entire estimated cost would be about £140,000, and the 4 per cent. guarantee would be £5,600. If they worked the line by electricity, as was proposed, it would increase the amount of guarantee. There was no railway line in the country that did not earn £12 a week per mile; and, assuming that the proposed line fell to that figure, it would earn £17,472 per annum. It was thought that the Dublin United Tramway Company might be induced to extend their line from Glasnevin to Finglas, where the proposed Slane railway would take it up, but a letter from the secretary of D.U.T. Company was read which quite dispelled the idea.

Derby to Nottingham.—The Market Harboro' Council has been advised that a scheme is coming forward for an electrical light railway from Derby to Nottingham. Electric light and power supply are also part of the project.

Epsom.—The L.U.T. Company will for the present abandon their tramways scheme for the Epsom district, the Highways Committee there having laid it down as a *sine qua non*, that the Epsom High Street and other narrow thoroughfares must be widened before they consent to any tramway proposals.

Farnham and Haslemere.—One of the largest landowners on the line of route has written approving of this electric tram scheme. We are informed that local opinion seems to be almost entirely in its favour.

Heston and Isleworth.—The U.D.C. has approved of the L.U.T.'s plans for the Twickenham Road tramways, subject to the roadway being widened to at least 30 ft., the road to be wood-paved, lit by electricity, and the poles to be at least 31 ft. apart.

Ilkeston.—Extensive preparations for laying down the electric tramways at Ilkeston are being made by the contractors, Messrs. Dick, Kerr & Co. It is expected that the work will be completed within six months. The length of the lines proposed to be made is over 3 miles, and extends from Cotmanhay to Hallam Fields, the northern and southern extremities of the borough. In the first instance the Town Council proposed to erect works to produce their own electrical energy, but subsequently arrangements were made with the Derbyshire and Notts Electrical Supply Company to furnish the requisite energy for the tramways and electric lighting, the company undertaking to do so on or before August 7th next. The principal streets of the town are to be lighted by means of arc lamps.

Kidderminster.—Last Friday one of the two new turbine engines was started at the works of the Kidderminster Tramway and Electric Company. These engines, which have been put down by the local staff of the company, under Mr. J. B. Clarke, will treble the capacity of the plant.

Liverpool.—On Thursday last week a telephone wire fell in Victoria Street, Liverpool. The guard wire was borne down by the fallen telephone wire, and both fell on the trolley wire, causing much sparking.

On Monday evening one of the automatic cut-offs, which have lately been introduced on the tramway system, had an opportunity of demonstrating its utility. The trolley of a car on the Derby Road route left the wire, and rising sharply, struck and broke the span wire. This brought the automatic cut-out into play, and the current was diverted from the section. A stoppage of the cars on the north and south routes for about half an hour was occasioned.

The incorporation of the town of Garston with Liverpool will necessitate the taking over by the Liverpool City Council of the undertakings of the Garston Electric Lighting and Tramways Companies. These undertakings will be acquired by the Liverpool City Council on terms which will be hereafter agreed upon by the respective parties.

London—Dover.—The newspaper press says that a scheme is on foot for an electric railway between London and Dover. It is understood to be part of a programme of electric railway undertakings by gentlemen who are connected with the existing tube railway in London and other electrical schemes, for which Bills have already passed their first reading in Parliament. The general idea appears to be for a direct line to Dover, running from Waterloo, and through Maidstone, with branches to Ramsgate, Margate, and Folkestone. It is the object of the promoters, as far as possible, to make a straight line between the points, in order to save mileage.

Merthyr.—Owing to one of the generating machines getting out of order recently, the trams were stopped for over an hour, but the lighting of the town was not interfered with. The company are erecting additional storage batteries in order to render a recurrence of the mishap impossible.

Manchester.—On 24th ult. Sir F. Bramwell, sitting as umpire, resumed the arbitration to decide questions arising out of the taking-over by the Manchester Corporation of certain tramlines and other property belonging to the Manchester Carriage and Tramways Company. Mr. G. Hopkins, engineer to a London tramway company, and Mr. J. More, of Edinburgh, gave evidence as to the value of the permanent way and materials in stock. The inquiry was adjourned.

A meeting to consider the proposed scheme for the Manchester electrical light railways will be held shortly, when plans and full details of the proposed railways will be submitted by the engineers. The districts to be served by the first section of the proposed light railways are the southern and south-eastern suburbs of Manchester, including Sale, Northenden, Dickoury, Gatley, Cheadle, Cheadle Hulme, Hazel Grove, Marple, Moltram, Glossop, Hyde, and Stalybridge.

Middlesex.—The Middlesex County Council are applying to the Light Railway Commissioners for powers to construct six different sections of light railways. A local inquiry was to be held by the Commissioners on Wednesday, October 30th, at East Finchley.

Oldham.—Since the four sections of the electrical tramways were started over a million passengers have been carried on the cars. The leases of the Manchester Carriage Company and the Barry, Rochdale and Oldham Tramway Company of the lines in the borough expired last night. This morning the Corporation will have fully 1,000 men engaged on the work of relaying the tracks. The work of fixing the poles has been going on for some weeks, and it is expected that the interval between the discontinuance of the horse and steam trams and the running of the new electric cars will be only a matter of a very few weeks. Orders for the requisite new cars were placed with Messrs. Dick, Kerr & Co., of Preston, some time ago, and in a couple of months 30 additional cars will be in use. The Hollinwood section is 4½ miles long and the Royton to Hathershaw length of tramway 4 miles. Other lines to be constructed are from Werneth to Rochdale Road, and Henshaw Street to the borough boundary at Burnley Lane. The plans at present show about 19 miles of route and 25 of track within the borough, and the estimated cost is £387,000. It is, however, intended to have double tracks wherever possible, and this, together with the cost of a new depôt and workshop off Middleton Road, will greatly increase that sum. The depôt at Mumps, which is rapidly nearing completion, will hold 70 cars. In addition to the above details, the Corporation are negotiating with practically the whole of the neighbouring authorities with a view to the extension of the service in every direction within the Parliamentary borough.

Oxford.—The Tramways Company will shortly bring before the Council a scheme for the electrification and extension of the tramway system at a cost of about £100,000.

Penge.—The B.E.T. has notified the Council that it proposes applying for tramway powers for the district. The Council, however, is considering the question of municipal trams.

Pontypridd.—The Earl of Jersey, president of the Light Railway Commissioners, Colonel Boughey, and Mr. Allan Steward held an inquiry at Pontypridd on Friday into the application of the B.E.T. Co. for powers to construct a light railway in the town from Tabernacle Chapel to the company's present terminus in Rhondda Road, and for powers to widen roads between the Porth terminus of the tramway and Tonypandy. Opposition was offered by various local public bodies and companies, and in the result the application to construct the railway was not granted, but the Commissioners granted an order in respect of the widenings subject to confirmation by the Board of Trade.

Portsmouth.—The breaking of a trolley wire put the car service out of gear for a short time on 19th ult.

Rockhampton (Queensland).—We have before us a copy of a report which was recently made to the Rockhampton Council by Messrs. Trackson Brothers, of Brisbane. The report quotes figures showing the economy that is brought about in working expenses when electricity takes the place of other forms of traction, and statistics are reproduced from the ELECTRICAL REVIEW'S electric tramway sheet to indicate the costs of working in some English cities. The overhead trolley system was recommended for Rockhampton, and particulars of proposed routes are given in the report. The various points in the scheme are dealt with in separate sections, such as the site, power house and plant, track (4 ft. 8½ in.), overhead construction, cars and so on. Wooden poles and a cheap style of bracket are proposed. There should be 14 cars, some composite, some open. Altogether, there are between 7 and 8 miles of route foreshadowed for electrical equipment, the estimated cost being put down at £57,000, including certain arc lamps for public lighting.

Salford.—Good progress has been made lately with the reconstruction of the tramways for electric traction. The Pendleton route will not be ready until about November 21st, when the official opening of the new system will take place. Other sections will be completed very shortly thereafter.

An investigation has been made into the cause of the failure of the current on the Higher Broughton route of the Corporation tramways, and from this it would appear that it is due to some workmen, without authority, taking out fuses from the section boxes, and thereby disconnecting the current. Steps have been taken to prevent a repetition of the occurrence.

Scarborough.—The Corporation have sealed the agreement with a company, for which Mr. A. A. Campbell Swinton is the engineer, for the construction of some 6 miles of electric tramway within the borough.

Spain.—The construction of an electric tramway from Villacarrillo to Linares and from Linares to Carolina has been definitely decided upon. The works will be commenced simultaneously at each of the three towns within three months of the declaration. Branches will also be constructed to Balza and to the Linares mines. The lines will be used for both goods and passenger traffic.

Application has been made for a concession for a projected electric tramway between Barcelona and Molins de Rey.

Stroud.—Last week it was feared that the action of the Gloucestershire C.C. would cause Mr. T. Nevins, electrical engineer, to abandon his scheme for constructing an electric railway connecting Stroud with several neighbouring towns. The difficulty arose with regard to Painswick, to which place Mr. Nevins did not at first see his way to lay the line. The C.C. made it a condition that Painswick should be included, and although the route is largely uphill, Mr. Nevins has decided to undertake the entire scheme, and the necessary preliminaries will be commenced forthwith.

Sutton.—At a special meeting of the U.D.C. on October 23rd it was agreed to hear an address from Mr. E. Price Edwards, who handed in a memorial of 450 signatures protesting against the introduction of tramways, on the ground of spoiling the residential and rural character of the locality, and emphasising the narrowness of High Street and other thoroughfares. A deputation of four gentlemen from Belmont Parish also handed in a memorial with 450 signatures, urging the Council to promote a tramway scheme to facilitate communication with Sutton, the last down train at present being at 7.30 p.m. Yet another petition of 493 names was presented in favour of tramways, but urging the Council to safeguard local interests. The petitions having been referred to a committee, Councillor Crook moved that the Council should strenuously oppose the tramways proposals, but Councillor Leaver moved, as an amendment, that a post-card poll be taken. The amendment was carried after a discussion lasting two hours. From the Committee's minutes it appeared that the subject of applying for a provisional light railway order had been discussed at two special committee meetings without any decision being arrived at. Later information indicates that the Surrey County Council has been informed of the withdrawal of the L.U.T. scheme for Sutton and Epsom.

Torquay.—The Provincial Electricity Company have given notice of their intention to apply for a provisional order for running electric trams from Torquay to St. Marychurch and Paignton.

Victoria.—An Australian contemporary states that Mr. T. Roberts, the locomotive engineer, who has recently been for a trip round the world, has submitted a long and technical report to the Government on electric traction, as applied to tramways, and recommends the adoption in Adelaide of the overhead trolley system.

Walsall.—At a special meeting of the Town Council on Monday evening, the town clerk intimated that the purchase of the lines from the Tramway Company had now been completed, and the whole of the legal difficulties overcome.

Wolverhampton.—Application is to be made to the B. of T. for a prov. order authorising the construction of a tramway from Snowhill to Bilston Street, at its junction with Pipers Row.

TELEGRAPH AND TELEPHONE NOTES.

Cable Communications with our Colonies.—"A Correspondent," writing in the *Times*, says that the important work which the Eastern and Eastern Extension Telegraph Companies have for some time past been engaged upon, with a view to improving their cable service to South Africa and Australia, has received far less notice than might have been expected, considering that it has involved the laying of nearly 15,000 nautical miles of cable at an expenditure of over £3,000,000. The first part of this work consisted in the laying of a new cable between Cornwall and the Cape, which was completed in the early part of last year. The extension from South Africa to West Australia has just been successfully accomplished, leaving the remaining section—between Perth and Adelaide—to be laid early next year. The new route has connected British possessions which were previously outside the pale of telegraphic communication, such as the Islands of Ascension and St. Helena, in the Atlantic, and Rodrigues and the Cocos-Keeling Islands, in the Pacific Ocean, and has been provided by the companies without any Government assistance whatever in the shape of subsidy or guarantee. Telegrams exchanged with Australia by the new route will be transmitted entirely by the companies employés, instead of being handled, as heretofore, by operators belonging to different administrations. By this change a considerable improvement in speed and accuracy is expected to be effected. It should also be mentioned that substantial reductions of tariff, on a "standard revenue" basis, have been brought into force for telegrams exchanged between Europe on the one side and South Africa and the contracting States of Australia on the other side; and, if the "standard revenue" is maintained, the rates for such telegrams will be further reduced to 3s. per word on January 1st next, and to 2s. 6d. on January 1st, 1903. Moreover, large reductions of tariff will to-day be brought into operation for local telegrams exchanged between Australia and South Africa, which it is hoped will materially assist in developing the commercial intercourse that is so rapidly growing up between these important portions of the British Empire.

Hastings Telephones.—The T.C. Committee is to obtain fuller information from Eastbourne and Tunbridge Wells with reference to the municipal telephone question.

The Murray Telegraph.—Mr. Douglas Murray has completed the trials with the "long-distance, high-speed page-printing" telegraph system which he has been carrying out between London and Glasgow. The apparatus has given the utmost satisfaction, not only to the inventor, but also to the postal engineers who have been watching the experiments. A speed of 120 words per minute was attained, and maintained under conditions which were far from favourable. This speed only misses by 10 words per minute the highest speed yet claimed for the system. It was found that the automatic typewriting transcribers, although capable of a speed of 110 words per minute, showed a distinct tendency to drop letters at that and even lower speeds, so it was decided to use two typewriters, each working at 70 words per minute, and to use them for transcribing alternate batches of messages. Mr. Murray claims that his trials have amply demonstrated the superiority of his apparatus, and shown that, compared with the systems now in use, it is more durable, simpler, and easier to keep in order. It reduces the amount of skilled labour required, and gives clearer and more readable messages. We understand that further trials will be made in England, after which Mr. Murray is going to Vienna in order to try his system on the Austrian wires.

Nice—Marseilles Telephone.—The Municipal Council of Nice has completed an arrangement for a loan of 350,000 francs, at 3·75 francs per cent., with a view to the construction of a direct telephone line between Nice and Marseilles. The "Credit Foncier" have undertaken to finance the enterprise. The advantages of having these two important French towns in direct communication is evident, and efforts are being made to commence the work as soon as possible.

Postal Employés.—The Postmaster-General has appointed Monday, November 11th, at noon, for the reception of a deputation to discuss the question of the rights of combination among Postal employés. The members of the deputation were appointed by the Joint Committee of Postal and Telegraph Associations, and represent over 40,000 organised workers in the Post Office. The chief point to be argued is the limitation which the Postmaster-General now imposes in the choice of representatives. It is contended by the men that the right of combination without a free choice of representatives is a worthless measure. The Post Office officials reply that they refuse to recognise a representative unless he is directly and individually concerned in the matters upon which he has to make representations. They impose departmental qualifications, in fact, which override the elections of the aggrieved employés. This question will be very fully discussed on November 11th. The delegates are Mr. Geo. Raby, chairman of the Joint Committee, and Mr. C. H. Garland, one of its members.

Wireless Telegraphy.—A Press message from Paris states that there is a project afoot to connect Algeria with the French Soudan by means of wireless telegraphy across the Sahara Desert. Algiers is already connected by the ordinary wires with the Niger, and it would only be necessary to put this last point in communication with the other side of the desert. This project is connected with the recently-announced Government intention to connect all the French colonies directly with France, in order to escape the use of the English wires for telegraphic news.

The *St. James's Gazette* says that Colonel Pilsoudsky, the inventor of a system of underground wireless telegraphy, which was recently experimented with near Paris, will in a few days open communication by this means between St. Petersburg and Moscow. A number of French and English electrical engineers are going to Russia for the occasion. The Pilsoudsky apparatus is also being prepared for establishing wireless telegraphy between Odessa, Novorossiysk, Yalta, and Tiflis.

Telegraphic Interruptions and Repairs :—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 20, 1899 ..	..
Para-Maranham	March 1, 1900 ..	..
Cayenne-Pinheiro	Oct. 15, 1901 ..	..
Cap St. Jaques-Thuanan Haiphong	Oct. 17, 1901 ..	October 24.
Landlines :—		
"*Via* Hanekin" on Persian territory	Feb. 24, 1900 ..	..
Pekin-Kalgan	June 14, 1900 ..	..
Maimatchin-Kalgan	June 30, 1900 ..	..
Communication with Baranquilla and Cartagena	Dec. 8, 1900 ..	..
" towns of Venezuela ..	Oct. 31, 1900 ..	..
Blagowestschenk-Khabarowsk	Oct. 15, 1901 ..	..
Beyond Ashcroft, B.C.	Oct. 29, 1901 ..	..

CONTRACTS OPEN AND CLOSED.

OPEN.

Amsterdam. — November 18th. Electrical overhead construction, rail bonds, &c., for the City Council. See "Official Notices" October 18th.

Army Contracts.—The Secretary of State for War gives notice that tenders for specific quantities of the undermentioned articles will probably be invited from time to time during the next 12 months, namely :—Acids, Electrical Instruments, Telegraph Cable. See "Official Notices" October 18th.

Barking Town. — November 12th. An electrically-driven loco. crane, and permanent way for the U.D.C. See "Official Notices" October 18th.

Boulder City.—November 23rd. The Council invites tenders from manufacturers for the construction of a tramway system, plans and specifications of which are to be seen at the office of the Agent-General, London. See "Official Notices" September 20th.

Bury.—November 18th. 28 electric tramcars for the Tramways Committee. Lacey, Clirehugh & Sillar, engineers.

Dublin.—November 25th. The D.U. Tramways Co. wants tenders for stores, including car fittings, electrical supplies, &c. See "Official Notices" to-day.

Dundee.—November 11th. Eight tramcars for the T.C. See "Official Notices" to-day.

East London (S.A.).—November 26th. Tenders to Mr. R. N. Moir, Town Clerk, for 50-kw. alternator and engine. London agents, Messrs. Dyer & Dyer, Aldermanbury, E.C.

Hull.—November 28th. Six rotary transformers for continuous current transformation, 2,000 volts to 200 volts, 90 kw. each. See "Official Notices" to-day.

Islington.—November 26th. Arc lamps, columns, and cables for the Council. See "Official Notices" to-day.

Lancaster.—The Tramways Committee are advertising for tenders for :—

(*a*) Supply of rails, fish plates, bonds, &c.
(*b*) Laying the above.
(*c*) Supply and fixing of poles and overhead equipment.
(*d*) Supply of feeder cables and pilot wires.
(*e*) Cars.

London, E.C. — November 7th. Two hand-fed arc lamps for stage effects, for the Central Finsbury Radical Club in City Road. See "Official Notices" to-day.

Manchester.—November 6th. Tenders for the erection of electricity sub-stations at Bennett Street, Hyde Road, and at the Polygon, Ardwick, for the Corporation.

Manchester.—November 9th. Telescopic and rigid tower wagons for the Tramways Committee. See "Officia Notices" October 25th.

Manchester.—Two 6,000-h.p. triple-expansion engines, two 3,750-kw., three-phase alternators, 48 motor-generators for Stuart Street generating station, and sub-stations. See "Official Notices" October 11th.

Mansfield.—November 11th. The T.C. is now inviting tenders for the buildings of electricity and dust destructor works.

Oldham.—November 5th. Cables, joint boxes, motor booster, motor-generators, switchgear, &c., for the electricity works. See "Official Notices" October 18th.

Rochdale.—November 8th. Boilers, economisers, stokers, condensers, &c., for the electricity works. See "Official Notices" October 18th.

Rotherham.—November 6th. New Imbecile Block. The Guardians invite tenders for the fitting up of telephones, electric bells, and speaking tubes in connection with the new Imbecile Block. Particulars on application to Mr. J. T. Crowson, the Master of the Workhouse.

Rotherham.—November 12th. Wiring the Hospital for electric lighting. Specifications from the borough electrical engineer, Mr. E. Cross, Rawmarsh Road, Rotherham.

Spain.—November 4th. Tenders are being invited until November 4th by the municipal authorities of Burgo de Osma (province of Soria) for the concession for the electric lighting of the town during a period of five years. Tenders are to be sent to El Secretario del Ayuntamiento de Burgo de Osma (Soria), whence particulars may be obtained.

Spain.—November 15th. Tenders are being invited until November 15th by the Spanish Post and Telegraph Authorities in Madrid for the concession for the establishment and working of a telephone system in the town of Valdepeñas (province of Ciudad Real). Particulars can be obtained from, and tenders are to be sent to, La Direccion General de Correos y Telegrafos, Madrid.

South Lancashire.—November 4th. High and low tension cables, stoneware pipes, &c., for the South Lancashire Electric Traction and Power Company. See "Official Notices" October 18th.

South Lancashire.—November 25th. Overhead electrical equipment of lines for the S. L. E. T. and Power Company. See "Official Notices" October 25th.

St. Annes-on-the-Sea.—November 15th. Street mains for the U.D.C. See "Official Notices" to-day.

Swindon.—November 12th. Boilers, cooling tower, 10-ton crane and other plant for electricity works. See "Official Notices" October 11th.

Willesden.—November 12th. Boilers, steam dynamos, transformers, motor-generators, switch-gear, cranes, battery, mains, public lamps, piping, condensing plant, &c., for the D.C. electricity works scheme. See "Official Notices" October 25th.

Wimbledon.—November 14th. Tenders for wiring the electricity works. See "Official Notices" to-day.

Woolwich.—November 15th. Electrical instruments for the Council. See "Official Notices" to-day.

CLOSED.

Blackpool.—Various contracts in connection with the tramway extensions were down for acceptance by the Council on Tuesday :—Messrs. Lowdon Brothers, trolley poles; the British Insulated Wire Company, cables; the British Thomson-Houston Company, electrical equipment of 20 tramcars; and Messrs. Hurst, Nelson & Co., 24 maximum traction trucks.

Wolverhampton. — The Lighting Committee has accepted the following tenders :—Messrs. Korting Brothers (£371), for condensing plant, and Messrs. T. Parker, Limited (£182), for a motor and pump.

Woolwich.—The Council has accepted the tender of Messrs. James Allen & Sons at £395 for tanks at the electricity station. The other tenders were :—Carron Iron Company, £400; Lindsay, Neal & Co., £409; Barrowfield Iron Works, £418; Matthew Shaw, £434; Eastwood, Swingler & Co., £436; and the Jones Engineering Co., £455. It is promised that the local streets shall be lit by electricity before the end of December.

Wrexham.—On Tuesday the tender of Messrs. Jones and Cathrall, for providing an electric lighting installation at the butchers' and vegetable markets, Wrexham, was accepted by the Town Council.

FORTHCOMING EVENTS.

Friday, November 1st.—At 8 p.m. Institution of Junior Engineers. Meeting at the Westminster Palace Hotel. Chair will be taken by the retiring president, Sir Lowthian Bell, Bart., F.R.S., succeeded by Sir John Jackson, F.R.S.E., who will deliver his presidential address.

At 8 p.m. Institution of Mechanical Engineers. Extra meeting; adjourned discussion will be continued upon the "Second Report to the Gas Engine Research Committee," by Prof. Frederic W. Burstall, member, of Birmingham University.

Saturday, November 2nd.—Electrical Volunteers' smoking concert. (See "Notes.")

Monday, November 4th.—At 7.30 p.m. Society of Engineers. Meeting at the Royal United Service Institution, Whitehall.

Thursday, November 7th.—At 8 p.m. Civil and Mechanical Engineers' Society. Meeting at St. Ermin's Hotel, Caxton Street, Westminster. Paper on "Electric Traction," by Mr. B. Pontifex.

At 8 p.m. Chemical Society. Ordinary meeting at Burlington House, Piccadilly.

At 8.30 p.m. Röntgen Society. Ordinary general meeting will be held at 20, Hanover Square. Presidential address by Herbert Jackson, Esq., F.C.S.

Thursday, November 14th.—Meeting of the Dublin Section of the Institution of Electrical Engineers. Paper by Mr. P. S. Sheardown on "An Account of the German Tour of the I.E.E."

Thursday, November 21st.—Opening meeting of the Institution of Electrical Engineers.

THE "ELECTRICAL REVIEW" AS DEFENDANT.

The libel action of Mr. B. C. Pole against the Electrical Review was brought to an issue on Tuesday last, after dragging along its weary length since March of last year.

Editors of technical journals are naturally suspicious of contributions received from unknown sources, but as the "Note" on which this action was based was written by a valued contributor to the Review, there was no question in our minds as to its *bona fides*.

A significant feature of the trial was the fact that the plaintiff did not bring forward a single witness to back up the extraordinary and erroneous statements which have been published in his pamphlets.

There were no personal allusions in our "Note," for neither the writer nor ourselves had any idea that such a person as Mr. Pole existed until we received a letter from his solicitors; nevertheless, Sir Edward Clarke tried with consummate skill to make the question at issue that of an unfounded and unjustifiable attack on the plaintiff personally. Happily, the jury did not take this view, nor did the learned Judge, if we correctly grasped the points of his summing up, and so far as the technical side of the case was concerned, there was little difficulty in disposing of Mr. Pole's pretensions.

To those who gave evidence we offer our hearty thanks, also to the legal gentlemen who so ably defended us, especially to Mr. Lickfold, who has invariably prepared our case in the various actions in which we have so frequently been involved; our readers we refer to page 710 for a brief report of the proceedings.

NOTES.

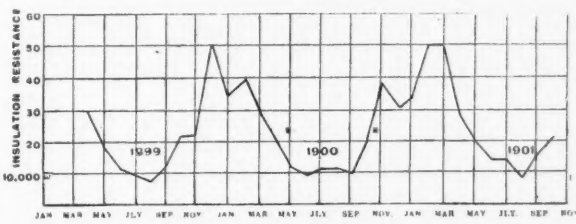
"Faradian" Club.—A most successful smoking concert was held in the rooms of the above Club, St. Ermin's Hotel, Westminster, on Friday, October 25th, Mr. James Swinburne, M.I.E.E., presiding over a company of 80. The chairman paid a high compliment to the Club quarters, situated so conveniently near Victoria Street, and attributed the large increase in membership amongst engineers in general to the advantage of the position and to the excellent catering; he was sure that club evenings, run on similar lines during the winter season, would be appreciated by all members present. A hearty vote of thanks was accorded the artistes who had ably assisted in the programme, viz.:—Messrs. A. T. Weir, T. Heffernan, Mr. J. F. Odgers, Will Ballard, James Horncastle, Alexander Prince, H. May Hemsley, and Wilson Tames.

Underground Conduit Traction for Chicago.—Instructions to investigate the feasibility of the underground conduit system in Chicago have been given by the City Council to its local Transportation Committee. It is held that there is a disposition on the part of the local street railway companies to defeat any change from the trolley to a conduit system, the assertion being made that the poor drainage of Chicago would make the change impracticable. The Transportation Committee, however, has been empowered to collect expert testimony from practical engineers as to the feasibility of conduit operation, and has also been instructed to report a plan of action that may be followed to demonstrate the possibility of operation of street cars by the conduit system before granting any extensions of existing street railway franchises. These franchises will soon expire, and assuredly the time for the Committee's investigations is ripe. Already the merits of one conduit system have been looked into, and a test on an unused portion of a cable road has been proposed. But this is only a small beginning, as there are many methods to examine and much experience of other cities to be learned and profited by before a thorough and fair report can be submitted to the Council for consideration.—*Western Electrician.*

Copper.—The New York correspondent of the *Standard* says that at Helena, Montana, 5,000 copper miners are idle, some on account of mine repairs, and others for no apparent reason beyond the determination to reduce the output. For example, the Trust and Competitor Mines, both of which have stopped, together aggregate 80 per cent. of the output of the Butte district.

Motor Vehicles.—Mr. Long, M.P., President of the Local Government Board, at the annual meeting of the Liverpool Self-Propelled Traffic Association, received a deputation on the question of the tare limit of motor vehicles for heavy traffic. The judges' report on the recent motor trials at Liverpool expressed the conviction that the limit of mechanical skill had not been nearly reached, with the result that in the trials only one heavy vehicle was actually within the legal tare limit. The total loads which could possibly be carried on these vehicles did not bring the total weight of vehicle and load to much more than half the loads that were frequently carried on lorries in large towns. This seriously interfered with their profit-earning capacity, and the removal of present restrictions was necessary so that heavier vehicles could be built. Mr. Long expressed himself in sympathy with the request of the Association, recognising that motor traffic was bound to develop in the near future.

Brooks Oil Insulation.—The adjoining figure illustrates the variations in the insulation resistance of a cable during the last three years. The cable is laid on the Brooks system, and is worked at a pressure of 2,500 volts. The noteworthy feature of the curve is the remarkable regularity with which, each year, the insulation increases to a maximum during the colder months, and



falls to a minimum during the warmer season. Incidentally, the curve shows also the value of records faithfully kept over a series of years, and periodically examined, instead of being consigned to oblivion in a pigeon hole. We have not previously met with a similar case of cyclic variation in insulation resistance, but perhaps some of our readers can afford an explanation. It may be due to the variation in the resistivity of the oil with temperature.

A B.A. for South Africa.—There is a movement on foot to found at Cape Town a South African Association for the Advancement of Science. There is also talk about the British Association holding one of its annual conventions in South Africa. We have no doubt that Sec. A. alone will be quite capable of dispersing the Boers, if the war is still "over" when they set foot on African soil.

A School Board's Exhibition of Scientific Apparatus.—It is stated that this week the London School Board intends to open an exhibition at the Examination Hall, Victoria Embankment, of scientific apparatus constructed by pupils and teachers for the purpose of teaching and illustrating some of the branches of experimental science. The exhibits include induction coils, telegraph instruments, motors, voltmeters, galvanometers, &c., used in the teaching of magnetism and electricity; Boyle's tubes, balances, &c., for chemistry; lantern and microscope slides for botany and physiology, and many others for use in the teaching of mechanics, sound, light, and heat, mensuration, and mechanical drawing. The exhibition was to open yesterday and close on Monday next.

Germany.—As showing the depression which exists at the present time in the German electrical engineering industry, a Continental contemporary publishes a list of 21 large concerns, the combined capital of which is no less than £22,177,500. At the present quotations of the various shares, the value of the capital is now only £8,637,000.

Military Motor Vehicle Competition. — From an advertisement in this issue it will be seen that the War Office Mechanical Transport Committee is offering three prizes (1st, £1,000; 2nd, £750; 3rd, £500), for the three tractors which, after an exhaustive series of trials (commencing in the spring of 1903), shall be adjudged to be the best suited to military requirements. The prizes may be doubled under certain conditions.

For Sale.—Rochdale Corporation offers dynamo, switchboard, and various electrical instruments, &c., for sale. See our advertisement pages for details.

Boilers for the Navy.—His Majesty's new sloop *Espiègle* began a trial of Babcock & Wilcox's boilers in the North Sea to-day, in the presence of the Boiler Committee.

Another Detachment of Electrical Volunteers for South Africa.—We understand that the services of a new detachment of the Electrical Engineers R.E. (Vol.), consisting of telegraphists, instrument repairers, linesmen, and wiremen is required for immediate service in South Africa. We are asked to state that members of the corps and others wishing to join should at once send in their names to the headquarters, Regency Street, Westminster, S.W., stating as clearly as possible their qualifications, age, height, &c. Appended are a few extracts from the regulations, embodying the conditions under which the last three detachments joined:—

The conditions of service with the Active Service Detachment Electrical Engineers R.E. (Volunteers) are as follows:—

Enlistment is for the remainder of the war, if it should last for more than one year, but if it should last a shorter time, for one year or for the remainder of the war, at your option. On the completion of service, discharge will be granted either in South Africa or in London, at your option.

Pay is according to rank, and engineer pay acording to skill.

Regimental Pay.

Rank.	Messing allowance.
Sapper .. .. .. 1s. 1½d.	.. .. 3d.
Second Corporal .. .. 2s. 2d.	.. .. 3d.
Corporal .. .. .. 2s. 6d.	.. .. 3d.
Sergeant .. .. .. 3s. 3d.	.. .. 3d.

Paid for every day of service from date of final approval.

Engineer Pay.

Qualification.	Per day.
Fair	8d.
Skilled	1s. 0d.
Superior	1s. 4d.
Very superior	1s. 8d.

Paid for every day employed.

Quarters or tents and rations issued free.

Uniform and equipment issued free by the Corps.

Gratuities at end of the War.

Volunteer gratuity, £5; War Office gratuity, £5; and one month's regimental pay if discharge is taken immediately on completion of service or on return to London.

Men are allowed to take their discharge in South Africa on completion of service, to enable them to take up their residence and work there if they wish to do so.

The first detachment of 50 men arrived in London after nine months' service with £625 in credit, not including gratuities or the one month's regimental pay on discharge.

Men are accepted if their qualifications seem sufficient, and on their passing the Medical Officer of the Corps. They are enlisted and approved, and from the date of approval—usually the next day to the medical inspection—they are soldiers and are required to attend here or elsewhere, as may be directed, for drill and other duties. A few days' leave may be granted to those who show good reason.

Lodging and ration allowance at the rate of 4d. and 6d. per day are paid from the date of final approval to the date of embarkation.

London County Council.—The Council at the meeting on Tuesday approved an estimate of £8,780, and authorised the acquisition of the freehold of the leasehold portion of the tramway depôt at Camberwell. Although the site is not to be used as a generating station in view of the facilities available at the Greenwich depôt, the depôt will continue to be employed in connection with the tramways, and it is probable that it may be found convenient to erect a transforming station on the spot.

The Parliamentary Committee reported having received a letter from the Camberwell Borough Council, asking the County Council to seek Parliamentary powers in the next session to enable Camberwell to acquire compulsorily a site for the erection of a generating station. At present the borough was in part supplied by the London Electric Supply Corporation, but the Camberwell Council had obtained an option for the purchase of the undertaking so far as it is within the borough, and intended to exercise the option and supply the electric light. The site proposed to be acquired abuts upon Hill Street, Peckham, and in part upon the Peckham branch of the Surrey Canal, and the town clerk had undertaken to render every assistance in making the necessary application to Parliament. The Parliamentary Committee expressed the opinion that the County Council should assist the Borough Council in the matter, and on their recommendation it was decided to apply for compulsory powers next session, subject to the Camberwell Council undertaking to defray the Parliamentary costs involved in the application.

Obituary.—Herr Josef Virag.—It is with deep regret that we record the death of Herr Josef Virág, joint inventor with Herr Anton Pollak of the well-known Pollak-Virág telegraph system. Herr Virág was born in 1870 at Földvar, and died at Buda-Pesth on October 24th, thus being only 31 years of age. He was educated in the Middle Schools of Brasso and Kolosvar, and subsequently at the Franz Josef Polytechnic at Buda-Pesth, where he obtained his diplomas as engineer. Some four years ago he was assistant to Prof. Wittman, with whom he remained three years. He was then appointed judge of patents at the Royal Hungarian Patent Office, a post in which he continued until his death. He occupied his leisure time in experimental researches of many kinds, and in 1898 began a series of experiments with Herr Pollak, which resulted in the production of the well-known telegraph system. After a long list of successful experiments with the apparatus, including experiments between Berlin and Buda-Pesth, and between New York and Chicago, a change was made in the invention, and in place of Morse characters, it was made to write in legible Latin characters, requiring no skilled transcription. A full account of the apparatus and results appeared in the Electrical Review. Recently a working line has been established between Buda-Pesth and Fiume, a distance of 600 kilometres, and excellent results obtained at a speed of 40,000 words per hour. Herr Virág was much respected among Hungarian engineers, and his early death is deeply regretted.

Appointments Vacant.—An electrical clerk of works is wanted for the Warlingham Lunatic Asylum by the Croydon Borough Council. A junior assistant engineer is wanted for Birkenhead tramways. An assistant engineer for Wakefield electricity works. A borough electrical engineer (£400) at Halifax. A working engineer is wanted by the Windsor Electrical Installation Company for its central station. An electrician, assistant, and others are wanted for electricity works at Pemberton. See "Official Notices."

Coal Consumption per Unit.—The letter from "W. H. J." in our "Correspondence" columns gives further interesting data regarding the abnormally low coal consumption per unit in his power station; moreover, from particulars and records which have been placed in our hands for our private inspection, we are bound to admit that during the greater part of the day's run the consumption is certainly not greater than 2·0 lbs. per unit, even when allowance is made for station motors, &c. Such excellent results as these, which represent a very high standard indeed, are a matter for sincere congratulation, both to the engineers directly concerned and to electrical industries in general. Of course, it must not be supposed that the average or monthly consumption is so low, on account of light load periods and stand-by losses; in speaking of lighting stations, for example, it is usual to include the coal used at such times, the year round. Nevertheless, making every allowance, the figures given will be very hard to beat.

Halifax Tramways.—The Corporation has this week received a rather pointed query from the Board of Trade as to whether the Corporation are prepared "to give an undertaking to equip their electric cars with means to prevent 'run-backs,' and with better life-guards." The Tramways and Electricity Committee have replied that "It is the intention of the Corporation to equip a car with means to prevent 'run-backs,' as an experiment, similar to those in use in Cincinnati."

Personal.—The President of the Board of Education has appointed Prof. Hugh L. Callendar, F.R.S., to the Professorship of Physics in the Royal College of Science vacant by the resignation of Prof. Rücker, who has become Principal of the University of London.

In consequence of the facts elicited at an inquiry into the administration of the Huddersfield tramways department and his refusal to appear before the Investigation Committee, Mr. J. Pogson, the tramways manager, has been asked to resign, and on Wednesday (October 23rd) he sent in his resignation. Mr. Thomas, the electrical engineer at the generating station, has been appointed to succeed Mr. Pogson.

The London County Council has, on the recommendation of the General Purposes Committee, appointed Mr. Maurice Fitzmaurice as chief engineer and county surveyor at a salary of £2,000 a year, in succession to Sir Alexander Binnie. Mr. Fitzmaurice was resident engineer for the Council at the Blackwall tunnel, and is now chief engineer of the Assouan Nile reservoir in Egypt.

Mr. W. H. Jones, who was for over eight years with Messrs. J. C. Howell, Limited, of Llanelly, and more recently at Cardiff, has been appointed district manager at Cardiff for the National Electric Wiring Company.

Mr. Robert Hammond has recently returned from a short visit to the States, where he has been studying electric railway development.

A New York exchange says that Sir Christopher Furness, who is one of the directors of the London Underground Railway, has been on a visit to the States studying electric traction.

The *Electrical World* says that Messrs. J. Upcott Gill and Alfred Bradley, who are associated together in the operation of the London and County Printing Works, Drury Lane, London, W.C., are now in the United States for the purpose of placing contracts for American equipment to be installed in a new works to be built here by them. The projected works will, it is claimed, be the largest of their description in Great Britain, if not in Europe. Electricity will be exclusively used to operate the various machines. Messrs. Gill and Bradley will visit Cleveland, Pittsburg, Chicago, Cincinnati, and other machinery centres.

Mr. L. B. Stillwell holds the appointment of electrical director in connection with the New York Rapid Transit Subway Construction Company.

Mr. L. W. de Grave has severed his connection as engineer and director for John Davis & Son, Limited, and is practising as consulting engineer at Chamwood Street, Derby. We understand he is shortly going to the Continent to report on some mining properties.

In commemoration of the twenty-fifth anniversary of the foundation of the firm of Messrs. Johnson & Phillips, telegraph and electrical engineers, of Charlton, a handsome silver bowl was, on Thursday evening last week, presented to Mr. Walter Claude Johnson at the works by Mr. J. Macgregor, general manager, on behalf of the staff, foremen and workmen, as a token of their regard and goodwill. The bowl was suitably inscribed, and there was also engraved on it a representation of a cable ship picking up broken cable by means of a grapnel. Nearly the whole of the 600 to 700 employés of the firm, of which Mr. Johnson is now the only member—Mr. Phillips having died several years ago—were present. Messrs. Macgregor, W. B. Esson, S. Paterson, E. G. Vacqueray, W. H. Johns, G. A. Hughes, and G. C. Pearson were the committee in charge of the testimonial fund. The chairman presented Mr. Johnson with a bouquet for Mrs. Johnson, and this was also suitably acknowledged. There were present several representatives of the leading electrical, telegraph and submarine cable companies, amongst whom were Mr. G. Draper, of the Eastern Telegraph Company, who interested his hearers by stating his early recol-

lections of the initiation of the firm and the large contracts it had carried out in connection with submarine cable enterprise.

Mr. Ernest O. Walker has resigned the position of managing director of Messrs. Walker & Hodgetts, Limited, St. Simeon's Electrical Works, Salford. His address is at present 10, Wright Street, C-on-M, Manchester.

Honours.—On Tuesday the King held an investiture at St. James's Palace. Mr. John Denison Pender was invested with the Order of St. Michael and St. George (K.C.M.G.), and Major R. E. B. Crompton, of the Electrical Engineers R.E. Volunteers, was made a C.B. (military).

THE CENTRAL STATION ENGINEER.

Mr. T. Dawson Clothier, who has just been appointed borough electrical engineer at Bootle, has been for the past four years an assistant at the Hull Corporation Lighting and Tramway Works. During this time he has seen a very great growth in the electrical undertakings of the Hull Corporation, and has been actively engaged in the "change-over" from low to high pressure of the electric lighting mains, and in the installation of the electric tram service. Before going to Hull he was for two years the chief assistant at the Stafford Corporation Works, and has also had some experience in the United States, which he visited on completion of his apprenticeship with Messrs. Poole & White. On Thursday last week the Tramways Committee of the Hull Corporation received his resignation with regret, and congratulated him on his new appointment. He leaves Hull with an excellent record, and with the sincere good wishes of many friends.

A propos of the above, it is interesting to note that Mr. Clothier is the fourth assistant to leave the Hull works to take up a position as chief of another station; Messrs S. E. Bastow (Barnsley), H. Gray (Accrington), and R. Pape (Morecambe), having all been assistants under Mr. Barnard, the city electrical engineer, Hull.

Mr. A. A. Watkins, second electrician-in-charge at the Bolton Electricity Works, has been appointed shift engineer to the Dundee Corporation Electricity Department.

Mr. H. F. Street has resigned the appointment of borough electrical engineer at Halifax, having accepted the berth at Southampton (£500), which has been rendered vacant by Mr. Chaplin's resignation. Mr. Street was at Halifax when the works started in 1894, as Mr. Wilmshurst's chief assistant, and when the latter gentleman went to Derby in 1898, Mr. Street stepped into his shoes. We believe that when the Halifax Committee found that they were likely to lose Mr. Street, they approached him with offers of largely increased salary if he would remain. Having accepted Southampton, however, he was in honour bound to abide by that acceptance. Our Town Councils are being taught some severe lessons in this matter of engineers' salaries; they too often awaken to the value of that official when he is about to take leave of them. Let us hope that in their new appointments, Halifax and other similar places will deal more generously with their officials.

Mr. H. J. Mills, whose marriage we announced last week, states that he is not assistant engineer at Beckenham Electricity Works. Mr. J. E. Tapper occupies that position.

The new borough electrical engineer, Mr. Prussmann, who was recently appointed to Swansea in succession to Mr. Cawthra, now of South Shields, has commenced his new duties. He states that Swansea's plant compares very favourably with that of any other town, but further extensions will be required next year to cope with the demand.

Mr. H. Holman has resigned his position as chief assistant at the works of the Weston-super-Mare and District Electric Supply Company, for another appointment—his place being taken by Mr. Arthur I. Wray, late of the Electric Lighting and Traction Company, of Australia.

Mr. F. W. E. Jones has recently accomplished the task of changing over the supply system of the Midland Electric Light and Power Company, Limited, at Leamington Spa, from two-wire to three-wire mains, without altering the generating plant. The pressure is 230 volts between the outers; it is intended to double the pressure of supply when the demand justifies this step, and already most of the supply is taken from the outer conductors at 230 volts.

Mr. R. W. L. Phillips, chief assistant engineer at the Bristol Electric Light Works, has been appointed borough engineer at Bedford, while his post at Bristol has been given to Mr. H. H. Couzens.

The Woolwich Borough Council, by its decision to purchase the Woolwich District Electric Light Company's undertaking, has raised the capital invested, or about to be invested, by the borough in electrical work to £200,000. Mr. J. B. Mitchell; the Council's chief electrical engineer, who has acted as sole adviser to the Council in the matter, has assumed control of the undertaking, and has connected the Woolwich works with the Plumstead area of supply, pending the completion of the new works at Plumstead next spring.

On Thursday last week a Smoking Concert, organised by members of the Liverpool Corporation Electric Supply Department, was held at the Alexandra Hotel, Dale Street. Alderman H. McCubbin occupied the chair in the unavoidable absence of the Chairman of the Electric Power and Lighting Committee, Mr. S. W. Higginbottom, M.P. The city electrical engineer, Mr. A. B. Holmes, and the leading members of the staff of the Electric Supply Department were present. The programme, which contained 23 items, was a very varied and interesting one. During the evening Alderman Williams pointed out the great advantage likely to accrue to members joining the technical classes held under the auspices of the Liverpool Corporation and University, and issued a warning note to the effect that if England was to keep pace with or stem the strong competition of the energetic American or plodding German, it was very necessary that greater interest should be taken in measures promoting technical education than had been the case in the past.

CITY NOTES.

Western Telegraph Company.

Mr. W. S. Andrews presided on Wednesday over the fifty-sixth ordinary general meeting of the shareholders of this company held at Winchester House. In proposing the adoption of the report, he said it would perhaps not be inopportune for him to remark at that meeting that the past half-year concluded the first complete year, from June to June, of the amalgamated companies' working, and it would be observed that the results of that consolidation continued to be wholly satisfactory. With respect to the receipts for the half-year, it must be remembered that a reduction in certain of the company's tariffs took place during the half-year under consideration, and it was expected that these reductions would make themselves very perceptible in the revenue. There was, it was true, an increased number of words transmitted on the company's lines, but they had not been sufficient to meet the entire loss by the reduction. But there had been a rise in the number of exchange telegrams which had come in and helped somewhat to minimise the loss. As a consequence, in the gross receipts there was a loss of £2,886, caused by the reduction, from which the company had been able to confer a boon upon the telegraphic public. The aggregate revenue for the half-year amounted nearly to the same figure as in the corresponding period of 1900, it being £228,892 against £230,434, a difference of £1,542. He had previously stated that there was a difference of £2,886 in the gross receipts, but there was a small increase in the transfer fees and from dividends on investments. The augmentation in the London expenses compared with the preceding half-year amounted to £1,246, of which £1,211 represented non-recurrent items. The net increase at their stations abroad was £1,676, which had been mainly due to the increase in the automatic working department, and to additional service of staff. Travelling expenses had increased by £622, and there had been an expenditure of nearly £600 more for a new landline at Rio. The largest item of increased expenditure was in cable repairs, there being an increase of £9,164, of which nearly £9,000 was for an additional cable used whilst repairs were being carried out. This was an item of course entirely beyond the control of the directors. They had also had to spend £600 for the automatic working in the electrical department, and they had to add £2,500 which had been given to the widow of their late manager. The net result of all these items, after deducting £10,291 for debenture interest and sinking fund, left them with a balance of £115,851, to which had to be added £7,689, making a total of £123,540. The quarterly dividend of £31,891 had already been paid, and the directors had transferred £35,000 to the general reserve fund, and £2,000 to the ship's maintenance fund, and now recommended a final dividend of 3s. per share, making, with the interim dividend, a total of 6 per cent. for the year, and also a bonus of 2s. per share, which would absorb £51,982, leaving a balance of £3,368 to be carried forward. He thought they might go a step further, for it was true they were not comparing the receipts of the June half of 1901 with those of the December half of 1900. Comparing them with those of the December half of 1900, the expenditure on cables showed an increase of £900, and the increase in the receipts during the last half of 1900 was due to the interruptions and insufficient working of competing lines, and the consequent solution was that the mercantile public had taken advantage of the company's route. In comparing the current receipts with the corresponding periods of 1897-98-99, they had increased in a very satisfactory manner, and were still increasing. At the last meeting he had referred to the cable laid in 1874 between Lisbon and Madeira, which had broken down. It had since been repaired at a depth of 2,500 fathoms, and when it was brought up it was reported to be in a good condition. On September 7th one of the cables between Madeira and St. Vincent became interrupted and was now being repaired. The unissued debenture stock had recently been allotted by the directors on very satisfactory terms. He trusted the shareholders would appreciate the honour his Majesty the King had conferred upon Sir John Denison Pender, one of their directors.

Sir John Wolfe Barry seconded the motion, and the report was unanimously adopted.

Stock Exchange Notices.—The Committee has been asked to appoint a special settling day in Willans & Robinson, Limited—16,666 ordinary shares of £5 each (issued at £3 premium), £5 paid (of which £3 is capital and £2 premium), Nos. 125,001 to 141,666; and 16,666 6 per cent. cumulative preference shares of £5 each (issued at £1 premium), £4 paid (of which £3 is capital and £1 premium), Nos. 100,001 to £116,666.

Prospectus.—The Tyneside Tramway and Tramroad Company are inviting applications for the issue of £120,000 in £10 shares. The list closes to-day.

TRAFFIC RECEIPTS.

Blackburn Corporation Tramways.—The receipts for the week ending Oct. 25th were £539; corresponding week last year, £489; increase, £100. Total to date, £21,759, corresponding period last year, £19,350; increase, £2,409. Miles of track open, 8¾.

Blackpool and Fleetwood Tramways.—The receipts for the week ending October 26th were £244; corresponding week last year, £218; increase, £26. Total receipts to date, £19,413; corresponding period last year, £18,881; increase, £532.

Bristol Tramways and Carriage Company.—The receipts for the week ending October 25th were £3,895; corresponding period last year, £2,973; increase, £922.

British Electric Traction Company.—The following returns are issued of the undertakings of this company for the week ending October 18th :—

Company.	Amount £	Comparison with corresponding week of last year. + £	Comparison with corresponding week of last year. − £	No. of weeks.	Aggregate. Amount. £	Aggregate. Inc. or Dec. + £	Aggregate. Inc. or Dec. − £
Croydon*	689	435	—	42	12,788	135	—
Devonport	261	—	—	17	6,874	—	—
Dudley—Stourbridge	719	383	—	42	27,741	15,119	—
Gateshead	602	—	—	28½	13,768	—	—
Greenock-Pt. Glasgow	209	—	—	2	442	—	—
Hartlepool	232	41	—	42	9,647	1,201	—
Kidderminster	119	29	—	42	5,256	634	—
Merthyr	243	—	—	28	7,286	—	—
Oldham—Ashton	514	500	—	42	21,108	2,280	—
Poole	240	—	—	28	8,484	—	—
Potteries	1,428	260	—	42	58,752	18,157	—
Southport†	157	—	8	42	7,086	—	†2,650
South Staffordshire‡	846	107	—	42	32,693	2,377	—
Swansea	456	67	—	42	18,638	4,130	—
Taunton	75	—	—	8½	870	—	—
Tynemouth	188	—	—	30	9,001	—	—
Wolverhampton Dist.	89	37	—	42	2,684	565	—

* Partly horse. † Reconstructing. ‡ Part steam.

The following returns are issued of this company for the week ended October 25th :—

Company.	Amount £	Comparison with corresponding week of last year. + £	Comparison with corresponding week of last year. − £	No. of weeks.	Aggregate. Amount. £	Aggregate. Inc. or Dec. + £	Aggregate. Inc. or Dec. − £
Croydon*	636	387	—	43	13,424	520	—
Devonport	382	—	—	18	7,256	—	—
Dudley–Stourbridge	700	173	—	43	28,441	15,292	—
Gateshead	616	—	—	24½	14,383	—	—
Greenock-Pt. Glasgow	155	—	—	3	597	—	—
Hartlepool	231	40	—	43	9,859	1,241	—
Kidderminster	117	19	—	43	5,373	653	—
Merthyr	189	—	—	29	7,575	—	—
Middleton	—	—	—	—	—	—	—
Oldham–Ashton	507	494	—	43	21,615	2,724	—
Poole	241	—	—	29	8,714	—	—
Potteries	1,424	192	—	43	60,174	18,349	—
Southport†	145	—	16	43	7,231	—	†2,666
South Staffordshire‡	810	55	—	43	33,503	2 432	—
Swansea	449	53	—	43	19,087	4,183	—
Taunton	65	—	—	9½	935	—	—
Tynemouth	201	—	—	31	9,202	—	—
Wolverhampton Dist.	85	27	—	43	2,769	592	—

* Part horse. † Under reconstruction. ‡ Part steam.

Aggregate route miles, 1901, 140¼; 1900, 100¾.

Central London Railway.—The receipts for the week ending October 26th were £6,613; corresponding week last year, £6,102; increase, £511. Total receipts from July 1st (17 weeks), £100,374. Miles open, 6.

City and South London Railway.—The receipts for the week ending October 27th were £2,183; corresponding week last year, £1,866; increase, £317. Total from July 1st to date, £32,554; corresponding period last year, £26,458; increase, £6,096. Miles open, 4¾.

Cork Electric Tramways.—The receipts for the week ending October 24th show a substantial increase on the corresponding week of 1900. The earnings for the year up to October 24th, 1901, were £20,169 13s. 3d.; corresponding period of 1900, £17,876 18s. 2d.; increase, £2,292 15s. 1d.

Dover Corporation Tramways.—The receipts for the week ending October 26th were £208 10s. 1d.; corresponding week last year, £181 6s. 8d.; increase, £27 3s. 5d. Total to date, £9,563 5s. 1d.; corresponding period last year, £9,056 6s. 10½d.; increase, £506 18s. 2½d. Miles of track open, 3; Car miles run, 1901, 5,335; 1900, 4,978. Number of cars, 1901, 12; 1900, 11.

Dublin United Tramways Company.—The receipts for the week ending October 25th were as follows:—D.U.T. Co., electric cars, £3,431 17s. 0d.; D.S.D. Co., electric cars, £758 7s. 1d.; total, £4,190 4s. 1d.; corresponding period last year—D.U.T. Co., electric cars, £3,403 6s. 6d.; ditto, horse cars, £25 8s. 5d.; D.S.D. Co., electric cars, £740 18s. 1d.; total, £4,169 12s. 11d.; increase, £20 11s. 2d.; aggregate to date, £83,319 4s. 5d.; aggregate to date last year, £82,169 10s. 5d.; increase, £1,149 14s. 0d. The mileage worked is 45 miles electrically, as against 43 miles electrically, and two miles by horses, for the corresponding period last year.

Liverpool Overhead Railway.—The receipts for the week ending October 27th were £1,444; corresponding week last year, £1,518; decrease, £74. Total from July 1st to date, £27,890; corresponding period last year, £28,894; decrease £1,004. Miles open, 6 miles 57 chains.

STOCKS AND SHARES.

Wednesday Evening.

The weekly swing of the pendulum has brought pronounced pessimism into the Stock Exchange, and for a few days it looked as though the floor was on the point of falling out of the House. From Consols downwards, the markets suffered severe depression, but as we write some little cheerfulness is coming to light. The money market has suddenly assumed alarming proportions as a Stock Exchange factor, and for all the apparent ease which has been the prevailing feature in Lombard Street for weeks past, the appearance of a few large borrowers quickly changed the aspect of affairs. Stock Exchange humorists are talking of the Bank rate going to 8 per cent. before Christmas, but there can be no doubt that money is not to be as plentiful in the immediate future as it has been for the last few months. Investment securities are consequently lower, and the dealers, when discussing their respective departments, all sing the same dirge of dearer money. But what is wanted is not so much a 2 per cent. bank rate, as a healthy spurt of business. There is, however, a very fair amount going on in electricity supply descriptions, and some of the railway stocks are attracting a lot of attention, while the buying of National Telephones is strong and persistent. Orders come to market in a "spotty" kind of fashion, particular shares being singled out for especial regard, instead of business being active in the general lists.

The whole air is charged with talk of electric railways, tramways, and other ways, and Central London stocks are advancing by leaps and bounds. It is again the Ordinary and Deferred which are most in request, the Preferred stock not participating; it had its turn before either of the others as our readers will remember. Market estimates now put the dividend at 4 per cent. on the whole capital; but as it will not be discussed by the board for over two months, the Stock Exchange guesses bear an air of prematurity, to put it mildly. While Central Londons are soaring, Metropolitan stock is distinctly flat, and at 75 is a couple of points lower, District at 27¼ being also easier. The Board of Trade inquiry into the merits of the systems advocated by the two directorates, has failed to help the quotations of either stock, in fact, tired holders of Metropolitan Consolidated are evidently selling at this very time.

In the electricity supply market, Metropolitan Ordinary are the principal features of strength, the quotation recovering 10s. upon a few buying orders. Edmundson's Ordinary and Preference are now *ex* everything, and the lowered prices practically cover the rights and dividend. The new issue of County of London and Brush Preference commands no premium, nor has it any chance of so doing while the existing shares stand at 12½; the new are offered at £12, which seems remarkably high. No fears of the wireless electric lamp have yet invaded the supply section.

Calcutta Tramways shares are a good market, and the new issue is quoted better at 1½ to 1⅝ premium, showing a rise of 10s. per share in a few days. The Buenos Ayres and Belgrano Company is doing well, and the Ordinary shares are 2, the "A" and "B" Preference both keeping at 5½. Barcelona are unaltered at 8, but Cape Electrics are the turn harder at 2 *ex* dividend. It is curious to notice that Belfast Street Tramways, Dublin United, and Calcutta Trams are now all the same price, £12 middle. British Electric Tractions display a relapse of 10s., and there is a fair amount of business doing in them. North Metropolitan Tramways shares at 4¾ are no harder upon the proposal to electrify the company's system.

To the firmness of National Telephones we have already drawn attention, but while the Ordinary shares are being largely bought, the third Preference have weakened, and are no better than 4¾. Vague guesses are circulating as to what may be the details of the agreement between the Government and the company. One report—we give it simply for what it is worth—says that the Government has promised to provide the cost necessary for extension of the company's system pending the taking over of the concern, lock, stock and barrel, after the war.

Falls predominate in the telegraph market, due to the hardening of money. Eastern Ordinary stock and Eastern Extension shares at 140 and 14 respectively are now paying 5 per cent. to the purchaser, and, as we have previously pointed out, are cheap, when they yield the round amount. Eastern 3½ per cent. Preference has lost a point; so has "China" 4 per cent. Debenture. Great Northern of Copenhagen and Indo-European Telegraph shares have shed a sovereign each, their comparatively high quotations rendering them peculiarly susceptible to timorous influences outside the market. Globes are steady, the Ordinary having easily regained the 1s. 9d. dividend deducted the other day. African Direct Telegraph shares are 4.

A drop of 30s. in British Aluminium Preference will surprise nobody who has followed our remarks anent this concern. The price of the shares is now nominally 6. Edison and Swan are supposed to be half a crown easier, but the quotation has been more or less a fancy one for weeks. Callenders show no diminution of strength, despite their being *ex* the dividend of 5s. per share. Henleys, however, are 10s. down, and have come into line with Callenders once more. Advances in General Electric (1900) Preference and Debenture are worth noticing: the latter stock has placed two points to its credit this week. No market has yet been made in Tyneside Tramways or Poole and District Electric shares.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1898.	1899.	1900.	Closing Quotations Oct. 23rd.	Closing Quotation Oct. 30th.	Business done during week ended Oct. 30th, 1901. Highest.	Lowest
96,900	African Direct Telegraph, 4 % Debs	100	...	...	...	99 —102	99 —102	...	...
119,700£	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red. ...	100	...	...	...	78 — 83	78 — 83	...	...
822,700£	Anglo-American Telegraph	Stock	£3 9s.	73/6	3½%	52 — 55	52 — 55 xd	...	...
3,088,540£	Do. do. 6 % Pref	Stock	6 %	6 %	6 %	97 — 99	97 — 99 xd	98½	97½
3,088,540£	Do. do. Deferred	Stock	18s. %	£1 7s.	5s.%	9¾ — 10¼	9¾ — 10½	10	9 13/16
44,000	Chili Telephone, Nos. 1 to 44,000	5	3 %	4 %	5 %	3½ — 4	3½ — 4	...	...
13,333,300$	Commercial Cable	$100	8 %	8 %	...	175 —185	175 —185	...	...
1,589,496£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	100 —102	100 —102	101¾	101
16,000	Cuba Telegraph	10	8 %	7 %	...	5 — 6	5 — 6 xd	...	...
6,000	Do. 10 % Pref.	10	10 %	...	...	13½ — 14½	13½ — 14½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	3 — 4	3 — 4 xd	...	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...	...	9 — 10	8½ — 9½	...	...
30,000£	Do. do. 4½ % Debs.	50	...	...	...	100 —104 %	100 —104 %	...	...
60,710£	Direct United States Cable	20	3½%	3½%	3½%	10½ — 11½	10½ — 11½	...	...
104,300£	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	100 —103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	138 —143	138 —143	140½	138
1,826,888	Do. 3½ % Pref. Stock	100	...	...	...	95 — 98	94 — 97	96½	94
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	114 —117	114 —117	115½	...
300,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	13¾ — 14½	13¾ — 14½	14⅞	14 1/16
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	114 —119	113 —118	114½	...
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	...	5½%	...	100 —103	100 —103	100½	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	101 —104 %	101 —104 %	103	...
180,227	Globe Telegraph and Trust	10	5½%	5½%	5½%	11 — 11¼	11¼ — 11⅝	11⅛	11 3/16
180,042	Do. do. 6 % Pref.	10	6 %	...	...	15 — 15½	15 — 15¼	15 3/16	14 15/16
150,000	Great Northern Telegraph, of Copenhagen	10	12½%	...	15 %	30 — 32	29 — 31	...	...
78,000£	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	41 — 45	40 — 44 xd	41	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	...	...	...	102 —105	102 —105	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	...	2½%	...	¼ — ⅜	¼ — ⅜	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	4 %	5 %	...	⅝ — 1	⅝ — 1	...	...
590,000	National Telephone, 1 to 590,000	5	6 %	5 %	5 %	4¼ — 4⅜	4¼ — 4⅜	4⅜	4 5/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4⅜ — 5	4⅝ — 4⅞	4⅞	...
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	96 — 99	96 — 99	97½	97
500,000£	Do. 4 % Deb. Stock Red.	100	...	...	4 %	96 — 99	96 — 99	98	97¼
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	6 %	1/16 — 1 1/16	1/16 — 1 1/16 xd	1	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	...	...	...	100 —103	100 —103	...	...
11,839	Reuter's	8	5 %	5 %	5 %	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	125 —130	125 —130 xd	...	...
58,000	United River Plate Telephone	5	6 %	7 %	...	5 — 5½	5 — 5½	...	...
40,000	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	...	...	4¾ — 5¼	4¾ — 5¼	...	...
179,947£	Do. do. 5 % Debs.	Stock	...	...	...	102 —105	102 —105	...	...
171,000	West African Telegraph, 5 % Debs....	100	...	...	...	99 —102	99 —102	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	¼ — ½	¼ — ½	...	...
150,000£	Do. do. 4 % Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	100 —103	100 —103	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	7 %	14½ — 15	14½ — 15	15	14¾
75,000£	Do do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	103 —106	103 —106	...	...
348,777£	Do. do. 4 % Deb. Stock Red.	100	...	...	...	103 —106	103 —106	...	...
88,321	West India and Panama Telegraph	10	2 %	5%	...	¼ — ½	¼ — ½	⅜	5 16
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	...	...	...	5 — 6	5 — 6	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	...	...	...	3 — 5	3 — 5	3	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	...	...	...	101 —104 xd	101 —104	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	6 %	6 %	6 %	7⅞ — 8¼	7⅞ — 8¼	...	...
12,000	Do. do. 7 % Cum. Pref....	5	...	...	...	8¼ — 8⅝	8¼ — 8⅝	...	...
50,000	Charing Cross and Strand Electricity Supply	5	8 %	9 %	9 %	9 — 10	9 — 10	...	...
20,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5¼ — 5⅝	5 — 5½	5 5/16	...
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	6 %	5½%	4⅞ — 5¼	5½ — 6	...	...
150,000£	Do. do. do. % Deb. Stock Red. ...	Stock	...	...	...	109 —112	109 —112	110½	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579...	10	6 %	4 %	0 %	8 — 9	8 — 9	8⅝	8 5/16
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	11½ — 12½	11½ — 12½	11½	...
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	122 —127	122 —127	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	4 %	4 %	8½ — 9½	8½ — 9	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	12 — 13	12 — 13	...	...
200,000£	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	104 —107	104 —107	...	...
35,500	Edmundson's Elec. Corp., Ord. Shares	5	6 %	6 %	7 %	5⅜ — 6¼	5½ — 6	...	...
20,000	Do. do. 6 % Cum. Pref.	...	...	...	...	5¼ — 6	5½ — 6	...	...
120,000£	Do. do. 4½ % 1st Mort. Deb. Stock. ...	100	...	...	...	105 —108	106½ —106¼	...	...
21,000	Kensington and Knightsbridge Electric, Ord.	5	...	...	...	11 — 12	11 — 12	11½	11
90,000	Do. do. do. 4 % Deb. Stock	Stock	...	...	...	101 —104	101 —104	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1⅛ — 1⅜	1⅛ — 1⅜	...	...
49,840	Do. do. do. do. 6 % Pref.	5	6 %	...	...	4 — 5	4 — 5	...	...
250,000£	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	96 —100	96 —100	...	...
85,000	Metropolitan Electric Supply, 101 to 62,500	10	5 %	5 %	6 %	12½ — 13½	13 — 14	13⅜	13½
220,000£	Do. 4½% First Mortgage Debenture Stock	...	...	...	...	113 —116	113 —116	...	...
250,000£	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	97 —100	97 —100	...	...
6,452	Notting Hill Electric Lighting	10	6 %	7 %	7 %	15½ — 16½	15½ — 16½	...	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	15 — 16	15 — 16	...	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8¼ — 9½	8¼ — 9½	9	...
150,000£	Do. do. 3½ % Deb. Stock Red. ...	100	...	...	...	97 —100	97 —100	99½	99¼
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2½	2 — 2½	...	...
50,000£	Do. do. 4 % Deb.	100	...	...	...	80 — 90	80 — 90	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	2½ — 3	2½ — 3	...	...
79,900£	Westminster Electric Supply, Ord., 101 to 80,000... ...	5	12 %	13 %	10½%	11 — 12	11 — 12	...	...

* Subject to Founders Shares. † Quotations on Liverpool Stock Exchange..
‡ Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1898.	1899.	1900.	Closing Quotation Oct. 23rd.	Closing Quotation Oct. 30th.	Business done week ended Oct. 30th, 1901. Highest	Lowest.
20,000	British Aluminium 7 % Cum. Pref.	10	...	...	...	7 — 8	5⅛ — 6⅛	...	...
300,000*l*	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	89 — 93	87 — 91 xd	...	...
45,000	British Electric Traction	10	6 %	8 %	9 %	14 — 15	13½ — 14½	14½	14⅛
50,000	Do. do. 6 % Cum. Pref.	10	...	...	...	11⅞ — 12¼	11⅞ — 12¼	12⅛	12 $\frac{5}{16}$
350,000*l*	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	121 —124	121 —124	122½	121½
70,000	British Insulated Wire Ord.	5	15 %	20 %	15 %	8 — 9	8 — 9	...	...
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	5¼ — 5⅝	5¼ — 5⅝	5⅝	...
50,000	¶Browett, Lindley & Co. (1899), Ord.	£1	...	...	8 %	⅞ — 1	⅞ — 1	...	...
50,000	¶ ,, ,, ,, 6 % Cum. Pref.	£1	...	...	6 %	1 $\frac{5}{16}$ — 1 $\frac{1}{16}$	1 $\frac{5}{16}$ — 1 $\frac{1}{16}$ xd	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	2	5 %	6 %	...	1⅜ — 1⅝	1⅜ — 1⅝	1½	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000 ...	2	6 %	6 %	...	2 — 2¼	2 — 2¼	2 $\frac{1}{16}$	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	102 —105	102 —105	...	...
108,710*l*	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	99 —102	99 —102	...	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	15 %	15 %	15 %	16 — 17	16 — 17 xd	...	...
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5⅝ — 6¼	5⅝ — 6¼	...	...
90,000*l*	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	111 —115	111 —115	...	...
1,969,800	Central London Railway, Ord. Stock	Stock	...	...	...	104 —107	107 —110	108½	106
440,100	Do. do. 4 % Pref. Stock	Stock	...	...	...	105 —108	105 —108	107½	105¼
440,100	Do. do. Def. do.	Stock	...	...	...	101 —104	105 —108	105	...
655,000	City and South London Railway	Stock	2⅛%	1⅞%	1¼%	51 — 54	51 — 54	...	...
37,500	Do. do. Ord. shares Nos. 22,501 to 60,000	10	...	...	...	5 — 5½	5 — 5½	...	...
54,000	Crompton & Co., Nos. 1 to 54,000	3	6 %	7½%	8 %	3 — 3½	3 — 3½	...	...
100,000*l*	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	100 —105	100 —105	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	2½%	⅛ — ⅜	⅛ — ⅜	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	6 %	2½%	1½ — 2½	1½ — 2½	...	...
344,023*l*	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	80 — 85	80 — 85	...	...
100,000*l*	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	84 — 89	84 — 89 xd	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	1¾ — 2¼	1¾ — 2¼	2	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000... ...	2	7 %	...	...	2½ — 3	2½ — 3	...	...
182,500*l*	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	98 —102	98 —102	...	...
18,000	General Elec. Co. (1900) 5 % Cum. Pref.	10	...	...	...	9¾ — 10¼	10 — 10½	...	...
150,000	Do. do. 4 % Mort. Deb.	Stock	...	...	...	97 — 100	99 —102	...	...
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	14 %	15 %	20 %	16½ — 17½	16 — 17	...	...
35,000	Do. do. do. 4½ % Pref.	5	...	4½%	4½%	5½ — 6	5½ — 6	5 $\frac{1}{16}$	5 $\frac{9}{16}$
50,000*l*	Do. do. do. 4½ Mort. Deb. Stock...	Stock	...	...	...	112 —116	112 —116	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	22 — 23	22 — 23	22⅝	22 $\frac{5}{16}$
300,000*l*	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	100 —103 xd	100 —103	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3¼%	3⅜%	3½%	6⅝ — 6⅞	6 $\frac{1}{16}$ — 6 $\frac{3}{16}$	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5	...	13 — 13½	13 — 13½	...	...
7,500	Parker (Thomas), Limited, Ord., Nos. 1 to 7,500	10	...	...	...	15½—16½	15½— 16½	...	...
	§Rosling, Appleby & Fynn 6 % Cum. Pref.	£1	...	...	6 %	19/- to 20/-	... — ...	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	17½%	38 — 42	38 — 42	38⅞	38½
150,000*l*	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	... %	...	104 —106	104 —106	...	...
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000	5	8 %	12 %	12 %	10½ — 11½	10½ — 11½	...	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000...	5	...	...	...	5½ — 6 xd	5½ — 6	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	3 %	3 %	3 %	91 — 94	91 — 94	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § From Bradford Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, 2/—4/-
National Electric Free Wiring, 17/6 paid, ½—⅝.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 15½—16.
Do. do. Pref. (£10 pd.), 10½—10⅞.

* From Birmingham Share List. ¶ From Manchester Share List.

Bank rate of discount 3 per cent. (June 13th, 1901).

MARKET QUOTATIONS, Wednesday, October 30th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a ,, Nitric	per cwt.	22/-	22/-	..
a ,, Oxalic	per cwt.	32/-	32/-	..
a ,, Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	89/-	89/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	£33 10	..
a ,, ,, ..	per ton	£30	£30	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£13	£15	£2 dec.
a Benzole (90 %)	per gal.	7/-	7/-	..
a ,, (50/90%)..	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£22	£22	..
a Lead, Nitrate	per ton	£24	£24	..
a ,, White Sugar	per ton	£31	£31	..
a ,, Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	2¼d.	2¼d.	¼d. dec.
a ,, Caustic (75/80%) ..	per ton	£24	£24	..
a ,, Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	95/-	95/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6	£6	..
a ,, Recovered	per ton	£5 10	£5 10	..
a ,, Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a ,, Crystals	per ton	£8	£8	..
a ,, Bichromate, casks ..	per lb.	2¾d.	2¾d.	..

METALS, &c.				
Aluminium Ingots, in ton lots	per ton	£148	£148	..
,, Wire, in ton lots	per ton	£224	£224	..
,, Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots.. ..	per ton	£75 to £125	£75 to £125	..
c Brass (rolled metal 2" to 12") basis	per lb.	7¾d.	7¾d.	..
Tube (brazed)	per lb.	9¼d.	9¼d.	..
,, ,, (solid drawn) ..	per lb.	8¼d.	8¼d.	..
,, Wire, basis	per lb.	7¾d.	7¾d.	..
Copper Tubes (brazed) ..	per lb.	10d.	10d.	..
c ,, ,, (solid drawn) ..	per lb.	10¼d.	10¼d.	..
g Copper Bars (best selected) ..	per ton	£80	£80	..

METALS, &c. *(continued.)*		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£80	£80	..
g ,, Rod	per ton	£80	£80	..
e ,, (Electrolytic) Bars ..	per ton	£82	£82	..
e ,, ,, Sheets ..	per ton	£90	£90	..
e ,, ,, Rod ..	per ton	£84	£84	..
e ,, ,, H.C. Wire	per lb.	9¾d.	9¾d.	..
f Ebonite Rod	per lb.	8/-	8/-	..
f ,, Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/5	1/5	..
h Gutta-percha fine	per lb.	8/-	8/-	..
h India-rubber, Para fine	per lb.	3/6½ to 3/7½	3/6½ to 3/7½	..
i Iron, Charcoal Sheets	per ton	£18	£18	..
i ,, Pig (Cleveland warrants) ..	per ton	44/9	45/0½	3½d. dec.
i ,, Forgings, according to size	per ton	From £11	From £11	..
i ,, Scrap, heavy	per ton	50/- to 52/6	50/- to 52/6	..
i ,, Wire, galvanised No. 8 ..	per ton	£10	£10	..
g Lead, English Ingot	per ton	£11 12 6 to £11 15	£11 15 to £11 17 6	2/6 dec.
g ,, ,, Sheet	per ton	£13 10	£13 10	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£9	£9	..
d Mica (in original cases), small ..	per lb.	8d. to 9d.	8d. to 9d.	..
d ,, ,, ,, medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d ,, ,, ,, large ..	per lb.	3/8 to 7/3	3/8 to 7/3	..
p Phosphor Bronze, plain castings	per lb.	1/0½ to 1/3	1/0½ to 1/3	..
p ,, rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, ,, strip & sheet	per lb.	From 1/3	From 1/3	..
o Platinum	per oz.	£4 1	£4 1	..
p Silicium Bronze Wire	per lb.	10½d. to 1/0½	10½d. to 1/0½	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15	to £40	..
i ,, ,, in bars		£58	£58	..
g Tin, block	per ton	£116 10 to £117 10	£116 10 to £117 10	..
g ,, foil	per lb.	1/6	1/6	..
n ,, wire, Nos. 1 to 16	per lb.	1/8	1/8	..
p White Anti-friction Metals — "White Ant" brand	per ton	£35 to £65	£35 to £65	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	7d.	7d.	..
j ,, 6 lea. Flax	per lb.	5⅞d.	5⅞d.	..
j ,, 3 ply 10 lbs. Russian ..	per lb.	4 $\frac{13}{16}$d.	4 $\frac{13}{16}$d.	..
j ,, 10 lbs. Russian, single ..	per lb.	4¼d.	4¼d.	..
j ,, 180 lbs. Jute rove	per ton	£10 5	£10 7 6	2/6 dec.
k Zinc, Sh's. (Vielle Montagne brnd.)	per ton	£22 10	£22 10	..

Quotations supplied by { *a* Messrs. G. Boor & Co. *b* The British Aluminium Co., Ltd. *c* Messrs. Thos. Bolton & Sons. *d* Messrs. F. Wiggins & Sons. *e* Messrs. Frederick Smith & Co.

Quotations supplied by { *f* India-Rubber, G.-P. and Teleg. Works *g* Messrs. James & Shakspeare. [Co., Ltd. *h* Messrs. Jackson & Till. *i* Messrs. Bolling & Lowe. *j* Messrs. Walter H. Hindley & Co.

Quotations supplied by { *k* Messrs. Morris Ashby, Limited. *m* Messrs. W. T. Glover & Co., Ltd. *n* Messrs. P. Ormiston & Sons. *o* Messrs. Johnson, Matthey & Co., Ltd. *p* The Phosphor Bronze Company, Ltd.

THE INTERNATIONAL ENGINEERING CONGRESS OF 1901.

MODERN COMMUTATING DYNAMO MACHINERY.

(Abstract of Paper read before Section IX. by H. M. Hobart, M.I.E.E.)

(*Continued from page* 695.)

Tests with coils with different lengths of end-connections were then made on the three five-turn coils shown in fig. 23.

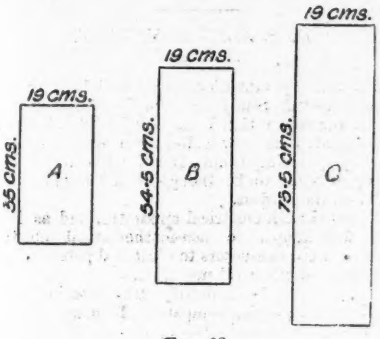


Fig. 23.

The "embedded length" was 49 cms. The coils were all 10 mm. wide × 20 mm. deep, and were measured in slots 10 mm. wide × 41 mm. deep. Measurements were made with the coils respectively at the bottom, at the top, and directly above the slots. The results are given in Table XVIII.

Table XVIII.

Coil.	Length of one turn in centimetres.	"Free length" in centimetres.	"Embedded length" in centimetres.	Ratio of embedded length to free length.	Inductance, with uni-slot alternator, in henrys.		
					Coil at bottom of slots.	Top of coil level with top of slot.	Bottom of coil level with top of slot.
A	105	56	49	·47	·000120	·000070	·000041
B	147	98	49	·33	·000124	·000079	·000054
C	189	140	49	·26	·000142	·000093	·000068

These results are plotted in three of the curves of fig. 24. The fourth curve is interpolated for the case of a coil lying half-way between top and bottom of the slot, but even this would not be the practical equivalent of an actual armature winding, since then, considering coils short-circuited at both the positive and negative brushes, the group of conductors concerned occupies the whole depth of the slot, and generally two neighbouring slots are concerned. For these reasons as well as because the measurements were made on the circuit of the uni-slot alternator, the results are considerably too high.

It will nevertheless be of interest to analyse the case equivalent to this fourth curve:—

1. When the 49 centimetres of "embedded length" constitute 20 per cent. of the length per turn:—

Lines set up by 196 cms. of "free length"	= 196 × ·8 × 5 =	784
Lines set up by 49 cms. of "embedded length"	= 49 × 4 × 5 =	980
Total C.G.S. lines linked with coil	=	1,764
Inductance for sine form of wave = 1,764 × 5 × 10^{-8}	=	·000088 henrys
Inductance from observations shown in fig. 24	=	·000138 "
Ditto corrected 15 per cent for wave form	=	·000120 "

leaving 36 per cent. to be accounted for by the less height of the coil, and by its not being spread out as it would be in an actual machine.

2. When the 49 cms. of "embedded length" constitute 50 per cent. of the length per turn:—

Lines set up by 49 cms. of "free length"	= 49 × ·8 × 5 =	196
Lines set up by 49 cms. of "embedded length"	= 48 × 4 × 5 =	980
Total lines linked with coil	=	1,176
Inductance for sine form of wave = 1,176 × 5 × 10^{-8}	=	·000059 henrys.
Inductance from observations shown in fig. 24	=	·000092 "
Ditto corrected for wave form	=	·000080 "

leaving, as before, 36 per cent. to be accounted for.

It might at first sight be objected to the method employed by the writer for estimating the reactance voltage, that it takes liberties with the general ideas of magneto-motive force in so considering the magneto-motive force per unit of length of coil, instead of considering merely ampere-turns. The observations already described fairly effectively dispel this objection. The following test still further justifies the method pursued:—

A coil was successively widened out to span more and more armature slots of a given core, and corresponding measurements of the inductance were made. The results shown in the curve of fig. 25 show comparatively little variation until the coil became extremely narrow.

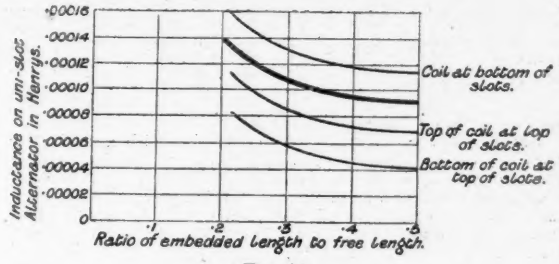


Fig. 24.

A similar test was made on the same coil when entirely free in air. It was successively narrowed up from an original width of 70 cms. down to a final width of only 20 centimetres. The value of the inductance in the final form is still 80 per cent. as great

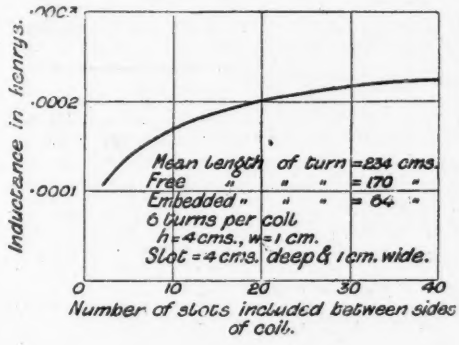


Fig. 25.

(expressed in C.G.S. lines per ampere-turn per centimetre of mean length of turn) as for the 3·5 times greater width of the coil in its original form. The results are plotted in the curve of fig. 26.

It may be thought that the results of this collection of inductance tests point to the advisability of using throughout some 10 per cent. to 20 per cent. higher constants in estimating the reactance

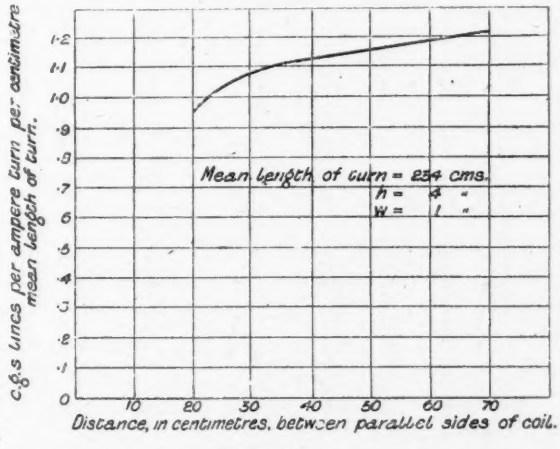


Fig. 26.

voltage. The writer would not be inclined to share this opinion. However, he attributes but little importance to any other than the *relative* values. If more satisfactory tests were at his disposal, pointing conclusively to higher values, corresponding to the actual conditions of practice, it would in no way affect his conclusions as to the relative merits of various machines, and he would merely scale up the numerical values of the reactance voltage and for the limiting safe values by 10 per cent., 20 per cent.

or whatever still higher increase seemed justified, right throughout the list. As to the relative influence of the "embedded" and "free length," the tests seem very conclusively to indicate the correctness of the ratio which the writer employs.*

The "two-circuit" or "series" or "wave" winding is not so readily analysed in this way. The writer prefers to make the calculation precisely as if the connections were those described above, remembering, however, to derive the reactance voltage from the larger current which, in such windings, flows in each conductor. Furthermore, it is desirable to keep within rather lower limits for the reactance voltage per segment. This is still more the case for "multiple" windings; in these the frequency of commutation and the number of turns simultaneously short-circuited under the brushes have to be determined by remembering that for, say, a double winding, the intermediate commutator segment has to be considered as added to the width of the two bounding insulations. Hence in such windings, for a given width of brush, the frequency of commutation is much higher than for a single winding.

Having studied this method in connection with a good many machines the writer finds that, with careful proportions in other respects, one may be very sure of excellent results with reactance voltages of not over 3 volts. Above 3 volts, except in the case of large slow-speed machines, one is liable to encounter trouble, which, however, if the value is not much in excess of 3 volts, is generally attributable to some other reason.

On large, slow speed, direct connected machines the permissible limit for the reactance voltage increases considerably with the size of unit. Thus for speeds of from 80 to 120 r.p.m. 3 to 4 volts may be used with perfect success for the range from 400 to 800 kw. It is impossible, in large sizes, to have so low values as in smaller machines. It is often practicable to obtain reactance voltages of from 1 to 2 volts, and where no other features are sacrificed by so doing, this is, of course, always very desirable.

Table XIX.

Reference No.	Number of poles.	Kilowatts output.	Speed—r.p.m.	Voltage.	Armature reaction in total ampere turns per pole.	Reactance voltage.	Average volts per segment.	Number of slots.	Width of slot (mm).	Depth of slot (mm).	No. of commutator segments.	Turns per segment.	Type of winding 2-circuit or mult. circuit (single).	Depth of air gap (mm).	Commutator diameter (cms).	Thickness of commutator of segment at surface (mm).	Diam. of armature (cms).
1	4	5 H.P. (Motors.)	900	110	1,000	2·1	6·6	67	6·1	15	67	3	2-Circ.	2·5	16	6·7	22
2	4	5 H.P. (Motors.)	900	220	1,000	2·8	10·9	27	11	18	81	5	2 ,,	2·5	16	5·4	22
3	4	7½ H.P. (Motors.)	850	110	1,300	1·8	7·2	61	7·6	19	61	3	2 ,,	2·5	19	9·0	25
4	4	15 H.P. (Motors.)	700	220	1,760	1·7	7·2	41	13	18	123	2	2 ,,	3·5	24	5·4	30
5	4	10	930	550	1,330	2·8	11·3	65	9·5	19	195	3	2 ,,	4	26·7	3·6	33
6	4	13½	1,400	550	1,200	2·5	11·3	65	10	15	195	2	2 ,,	4	26·7	3·6	33
7	4	14½	825	550	1,460	2·8	15·0	49	10·4	19·5	147	3	2 ,,	4	26·7	5·0	33
8	4	18½	770	550	1,930	2·5	14·4	51	11	22	153	3	2 ,,	4	27·9	5·0	41
9	4	30	600	115	3,880	1·4	3·9	119	7·5	17	119	1	2 ,,	5	45	11·1	52
10	4	27	715	550	2,320	2·4	11·6	63	12·6	18	189	2	2 ,,	4·5	32·5	4·7	46
11	4	40	600	115	3,780	1·7	5·3	87	8·5	20	87	1	2 ,,	5	35·6	12·1	52
12	4	30	600	230	2,890	1·1	5·2	59	15	15	177	1	2 ,,	5	45·0	7·2	52
13	4	35	975	230	2,450	1·7	7·1	43	15·2	17	129	1	2 ,,	4·5	38·1	8·5	46
14	4	33	660	550	2,680	1·5	6·2	119	8·0	20	357	1	2 ,,	5	45·0	3·2	52
15	4	33	1,100	550	2,000	2·0	8·2	89	7·2	17	267	1	2 ,,	4·5	38·1	3·7	44
16	4	38	1,070	550	2,150	1·7	8·8	83	8·6	19	249	1	2 ,,	4·5	38·1	4·0	46
17	4	50	1,020	550	2,700	1·6	9·3	79	9	18	237	1	2 ,,	5	3·81	4·3	52
18	4	60	960	550	3,230	2·1	9·3	79	10·5	18	237	1	2 ,,	5	38·1	4·3	52
19	4	45	925	230	3,000	1·8	7·6	121	5·9	21	121	1	2 ,,	5	38·1	9·1	52
20	6	40	240	110	3,800	1·9	1·8	125	9	27	125	1	2 ,,	5	38·1	8·8	68
21	6	75	500	600	3,340	2·2	11·3	160	7	33	320	1	2 ,,	5	48·2	4·8	67
22	6	130	500	110	3,800	2·2	5·7	116	9	26	116	1	6 ,,	6	63·5	16·4	85
23	8	80	750	115	3,500	2·0	2·9	84	12·1	27·5	336	1	8 ,,	5	48·0	3·7	68
24	8	250	100	550	7,800	2·2	4·0	364	9·6	29	1,092	1	8 ,,	9	165	4·7	187
25	8	300	375	550	5,000	2·9	7·7	192	10	29	576	1	8 ,,	8	95	5·2	150
26	8	400	100	550	9,000	2·8	5·6	264	12·3	33	792	1	8 ,,	10	165	6·6	230
27	16	1,000	90	500	9,000	3·9	7·7	384	13·4	32	1,152	1	16 ,,	10	270	7·4	350
28	22	1,600	84	550	8,000	3·8	9·2	440	14·0	34	1,320	1	22 ,,	10	350	7·6	450

As to why the larger sizes are rather less sensitive to high reactance voltages, the writer must freely confess that he has never yet found a satisfactory explanation.

The writer recently went through a very large number of machines, suggesting modifications and improvements, and at the same time adding to the system some new designs of both small and large machines. Especial attention was given to improvement in commutation, hence interest attaches to Table XIX., in which are set forth for 28 of them the normal ratings and some leading constants and dimensions. In the case of many of the small sizes the proportions are rarely such as one would select for new designs. Nevertheless, the table serves to indicate what the writer regards as safe values from the commutating standpoint for the speeds, voltages, and outputs set forth. Before these small machines were rearranged they were decidedly poor as regards commutation. In no feature of the design is it of greater importance to keep well on the safe side than with respect to commutation constants. For instance, in the last few designs in the list, the efficiencies at full load and half load are some ½ per cent. lower than might have been obtained for a given cost of material, by going 25 per cent. or so higher with the reactance voltage.

(To be continued.)

* This method of estimating the reactance voltage is based upon substantially the same principles as the method published two years ago by Mr. H. F. Parshall and the present writer.

ELECTRICAL COHERENCE.

The Evolution of an Observation.

By S. ALFRED VARLEY.

You have directed my attention to an article in the *Engineering Magazine*, headed—"A Study of the Electrical Coherer," and presumably for the reason that I was the first to observe, and turn to practical account, that now well-known property of conducting powders which plays so important a function in connection with wireless telegraphy, it seems to be thought that I might usefully make a contribution on the subject.

As a boy I played with electrical apparatus, and as long as I can remember it was known to *non*-mathematical electricians that metallic powders were conductors to electrical potentials, such as are developed by statical electrical machines.

In the early spring of 1852, shortly after entering the service of the pioneering telegraph company, I made the following observations:—(1) That metal dust opposed for all practical purposes infinite resistance to electrical currents of telegraphic potentials; (2) that metal chains (especially if slightly oxydised) opposed much greater resistance than a continuous wire of the same weight and length; (3) that if the links were brought into firmer contact with each other by subjecting the chain to mechanical tension, that then the electrical continuity became more perfect.

The immediate outcome of these experiments, made as far back as 1852, was the demonstrating that simple mechanical contact does not establish perfect electrical continuity, and it may also be said of these observations that they embraced the principle of action (1) of S. Alfred Varley's lightning bridges introduced in 1866; (2) of Prof. Hughes's microphone, invented in 1877; and (3) of the Branly and Marconi tubes of the nineties, both of which—*scientifically*, are identical with Varley's lightning bridge.

At the period when I carried out these experiments, telegraphic joints were mechanical ones (bell hangers' joints), and telegraph lines were to all intents and purposes metal chains, each link adding its quota of resistance, owing to the imperfect electrical continuity between link and link. Now, the additional resistance, due to imperfect electrical continuity at the joints, was in circuits of considerable length, a matter of serious practical moment, and this resistance increased from day to day, for as is now well known, but was not so generally appreciated in the fifties, work is done proportionately to the resistance electrical energy overcomes, and the form in which such work will be done where telegraph joints

are mechanical ones, is that of chemical action developing metallic oxide on the surfaces of the links, and as the metallic oxide formed is an insulator, it follows that it is only a question of time when the electrical continuity will become practically broken down altogether.

I called the attention of my immediate superior officer, the late Cromwell Varley, to the practical bearing of these observations and experiments of mine, and he realised at once their importance—the attention of the engineer-in-chief (the late Edwin Clark), was called to the matter, and shortly afterwards a very stringent order was issued from the engineer-in-chief's office, that all future joints must be made by soldering the wires together. A very considerable expenditure was also incurred over replacing the existing mechanical joints with soldered ones, and although Cromwell Varley was given the credit of detecting this defect in the telegraph circuits of that period, I had the satisfaction of feeling that my observations and experiments had been fruitful of immediate practical results.

When war broke out a few years later I was asked by the War Department to take charge of a field telegraph corps, the first occasion the telegraph was used for war purposes, and so I was privileged to see service in the Crimea. After the evacuation of Sebastopol and the arrangement of an armistice, I took charge of the Varna and Constantinople submarine circuit together with the land lines on the Constantinople side of the Black Sea. In the autumn of 1856 the telegraph instruments of Therapid were burst up by a lightning discharge, and what I then observed spoke eloquently, and brought home to me (1) why the telegraph protectors of that period failed to protect the instruments; (2) the conditions which lightning protectors must fulfil to be efficient; and (3) I was led to the conclusion that an ideal protector would be a bridge behaving to telegraphic currents in the same way as I had observed metallic powders did, but which at the same time should freely conduct electrical currents of higher potentials than those employed in telegraphy. But what was more particularly brought home to me was that the discharge which burnt up the instruments had evidently occupied time, seeing that the lever of the transmitting key had been moved through a space of about ⅓rd of an inch and brought into contact with an earth connection and welded to it by fusion.

In 1859 and 1860 I carried out somewhat exhaustive researches with conducting powders with a view to producing an efficient telegraph lightning protector. In these researches I employed voltaic potentials ranging from 10 to 700 volts, and also unknown statical potentials developed by a powerful induction coil. It was while carrying out these experiments that the property now known as coherence was brought forcibly under my attention, but it never occurred to me that I had tumbled upon a scientific discovery; I only regarded it as an interesting fact—a confirmation, or illustration, of what those who were capable of thinking in the language of electricity might naturally have expected.

Now, had I not as a scientific worker, again and again come into collision with the eccentricities of mathematical genius, whose contributions to applied electricity may be described as being for the most part an indulgence in wild flights of the imagination; tempered with hair splitting and swallowing camels, I should be at a loss to understand how it is at this time of the day, "coherence" should form the subject of a learned treatise by Prof. Oliver Lodge, and also that it should be the subject of scientific discussion in technical journals.

In wireless telegraphy the Marconi tube has to deal with rhythmical impulses of very low potentials, and he employs metal filings, but as I, on the contrary, was dealing with high potential discharges, it was obvious to me that metallic powders would be inadmissible for lightning bridges, seeing that the first discharge would fuse them together; and so my experiments of 1859 and 1860 were confined almost wholly to carbon powder pure and simple, and also to mixtures of carbon and highly refractory insulating matter.

The following is an extract from a paper read by me in 1870 at the meeting of the British Association, "On the Mode of Action of Lightning":—"It was well known that high tension electricity would leap across a small space of air in preference to passing through a coil of wire; this arose from the inertia resistance conductors oppose to polarisation or magnetisation—a resistance probably approaching infinite resistance, during an infinitely small interval of time. The author, when experimenting with electric currents of varying degrees of potential, observed the very great resistance which a loose mass of powder of conducting matter opposed to the passage of electricity of moderate tension; he found that a current of 50 Daniell cells did not pass through a loose mass of finely divided blacklead or wood charcoal. When the tension was increased to 200 or 300 volts, the particles arranged themselves by *electrical attraction*, making good electrical contact, and formed a bridge by which the electricity freely passed. With a tension of 700 cells an electric circuit became completed through a considerable length of the dust met with in rooms which consists chiefly of silica and alumina associated with soot and more or less organic matter.

Incandescent matter offers a very free passage to electricity; masses of highly-heated black lead powder were found with six volts to give an average resistance of five units, or about one-sixtieth of that opposed by an ordinary needle-telegraph coil, which may be taken at 300 units. These experiments went to show that an interval of dust separating two conductors opposes practically a decreasing resistance to an increasing tension, and led to the construction of the "lightning bridge," which consists of two pointed conductors, enclosed in a chamber, and approached to within one-eighteenth of an inch from one another, and surrounded with finely divided matter consisting of carbon and a non-conducting substance intimately mixed in suitable proportions determined by electrical tests. The reason why a powder consisting entirely of conducting matter cannot be safely employed is, that although it may oppose a practically infinite resistance to the passage of electricity of the tension of ordinary working currents, when a high tension discharge occurs, the particles under the influence of the discharge generally arrange themselves *so closely* as to make a *conducting* connection between the two points of the lightning bridge (in other words, cohere).

If the effect of lightning striking the wires be considered, it will be seen that the electric discharge passing through the telegraph coils *is not momentary, but occupies time.* When an insulated telegraph wire is struck, the effect of the discharge is to polarise the wire throughout; after the discharge the wire returns to its normal unpolarised condition; but the cessation of magnetisation, although rapid, *is not instantaneous*, and the effect of the wire assuming its normal unmagnetic condition will be to develop an electric current flowing in the same direction as the electric discharge which magnetised the wire. The tension of the current developed by the demagnetisation will be very high at its first development, and will rapidly afterwards fall to zero. There is, therefore, first the main discharge of electricity, which passes by the shortest route, and does not wait to polarise the coil-wires, but leaps across a space of air to the earth conductor as the easier course, followed by a secondary current in the same direction, *but occupying time.* The tension of this secondary current, although at first very high, is not nearly so great as the lightning discharge, and the greater portion, if not the whole, will pass through the coils, which oppose, *when time is given*, a much less resistance than the smallest possible space of air; it would therefore seem, when telegraph circuits protected by an ordinary protector are struck by lightning, it is to the secondary current, and not to the main discharge, the fusion must be attributed. The fact that the coils of needle-telegraphs are more often fused than other telegraphic apparatus was considered to be strong confirmation that the fusion was due to the secondary current developed by the demagnetisation.

When a circuit protected by a Varley 'lightning bridge' is struck, the lightning finds in its path not a space of air but a bridge of conducting particles in very close proximity to one another; it connects these under the influence of the discharge and renders the particles incandescent. Incandescent matter, as already stated, offers a very free passage to electricity, and the secondary current developed by the demagnetisation of the line wire, finds an easier passage across the heated matter than through the instrument coils."

The writer of the article in the *Engineering Magazine* refers to what he describes as "the extraordinary conflict of opinion which has obtained since Branly's discovery with regard to various qualities, such as the relative sensitiveness of coherers made with filings of different metals"—he goes on to say that the phenomenon of coherence, as Lodge affirms, is a welding together of the two surfaces in pseudo contact. Branly and Bose differ from Prof. Lodge, and also from one another, so it would appear that this trinity in unity of mathematical authorities do not cohere in their respective explanations of the phenomenon "Electrical coherence."

All useful scientific research may be described as the building up a structure or system by linking together observed phenomena in such a way as to form a continuous chain of links—in other words, a thread of continuity. Now, if metal filings or powdered carbon be compressed mechanically, the phenomenon known as coherence, will be brought about much in the same way as by electrical pressure, but I am disposed to think not so perfectly, for electricity, according to the views I hold, is inseparable from matter—and if I may so express it, is the genius of matter entering into its atomic constitution, and controlling it. Perform the following experiment:—Spread on a dry board a thin layer of either metal filings or powdered carbon intimately mixed with a percentage of insulating matter. Now insert into this powder the two poles of a voltaic battery of 700 volts, allowing a space of—say ⅛ in. between the poles; electrical induction which Faraday demonstrated to be the antecedent stage of conduction takes place immediately through the layer of powder, and you will see with your eyes the particles of conducting matter sieved out from the insulating powder and a continuous chain formed of conducting particles in such intimate electrical contact with one another that they cohere—such coherence being brought about by electrical pressure. When the conducting chain is complete an electrical circuit also becomes completed, and if the ampere current developed by the battery be great enough the metal filings will be welded together by fusion, and after that burnt up. The performance of this experiment has led me to the conclusion that the phenomenon, "coherence," is the antecedent stage of chemical union of matter with matter. We have first, ocular evidence of electrical induction, the antecedent stage of conduction, and, as consequence of induction, coherence, and after that, as a consequence of coherence, we pass on to the further stage—conduction followed by intimate chemical union between the metallic particles. What we see in the experiment now being referred to, may be described as a process of evolution, electrical induction evolving coherence, coherence evolving conduction, and conduction evolving chemical union.

I have already alluded to the fact that mechanical pressure as well as electrical pressure can bring about the phenomenon "coherence." The classical researches of Faraday have made plain to us how intimate is the relationship between induction and conduction, he has also taught us that there exists no hard and fast line separating insulators and conductors; all insulators conducting in a small degree, and all conductors insulating directly as their conductive resistance. Now what I want to point out is, that no hard and fast line divides mechanical contact from chemical contact—in other words, chemical action.

I myself, consider that mechanical contact—say between metal and metal—should be regarded as the antecedent stage of chemical action. Sir W. Chandler Roberts Austen's interesting observation that gold and lead diffuse through each other when in simple mechanical contact, goes to show that mechanical contact, alone by itself, results in chemical union, and if mathematical physicists could only grasp the fact as knowledge that a thread of continuity unites all phenomena—and if only they were able to regard physics from that broad angle of vision which all true disciples of Davy and Faraday, in a greater or less degree, are capable of doing, then the well known fact that when two metal plates whose respective affinities for oxygen differ, are brought into simple contact, the plates then become electrically charged statically, similarly as when they form the elements of a voltaic couple, would be regarded as going to show that no hard and fast line separates chemical contact—that is to say, chemical action, from mechanical contact.

In the year 1852, and at a time when England was covered with a network of telegraphs, that able mathematician and representative physicist, the late Prof. Airy, protested before the Institution of Civil Engineers against telegraphs being called electrical, for, as he averred, there was no connection between electricity and galvanic currents with which the telegraphs were worked; and, what is to me more strange and almost inexplicable, is that only a few years ago I heard Lord Kelvin himself, at the Royal Institution of all places, assert *ex cathedrâ* most emphatically, that Davy and Faraday were wrong in attributing the development of electricity to chemical action, and that Volta was right in attributing it to mechanical contact. As an earnest scientific worker to whom science is a sort of religion, regarding it as the elucidation of truth, I have always wanted to be able to reverence the "tremendous" name of England's greatest mathematician, and when, as I have from time to time heard Lord Kelvin give utterance to what I consider rash *ex cathedrâ* assertions, it has always been painful to me. I well remember how I myself, in common with the members of the British Association generally, was impressed when I met him at Liverpool in 1854, and I also well remember the few words he spoke to me, which were that those who had the control of telegraph lines like myself should publish what came under their observations for science *to deal* with—he did *not* say to patent and make a monopoly of the outcomes of such observations As a matter of fact, my late brother, Cromwell Varley, Lord Kelvin, and others also, have pecuniarily benefitted from direct outcomes of my researches very much more than I have done, but this is a digression.

The late Clerk Maxwell in the preface of his treatise on magnetism, says that the most important aspect of science from a mathematical standpoint is that of a measurable quantity. Lord Kelvin has gone much farther than this, for he asserted in a lecture, which has been published, that no one can be said to have a scientific knowledge of anything until he deals with it in figures. Now, if this dictum be true, it then follows that Faraday himself had no scientific knowledge of electricity. The history of applied electricity, if only truly written, goes to show that mathematical savants, more often than not, have been retarders of practical advances at the pioneering stages, and for the reason that they are men of learning rather than men of knowledge.

ENGINES FOR DRIVING LARGE DYNAMOS.

Read Saturday, October 12th, 1901, before the Manchester Association of Engineers by CHAS. DAY.

In the early days of electrical engineering, dynamos were designed without special reference to engines. Engines of suitable power were then obtained and set to drive the dynamos by means of belts or ropes. This practice may be said to be absolutely abandoned, and large dynamos are now invariably fixed direct to the engine crankshafts so as to save space transmission losses and cost of belt up-keep.

On the Continent and in America slow-speed engines have been almost exclusively adopted, but in England by far the majority of engines to be found in electric generating stations are high speed, and it is interesting to consider why English engineers have not followed the American and Continental lead. The answer is at once creditable, and otherwise, to English engineers. Creditable, because our engineers have had the courage to take a new view of the situation and back their opinions by tackling the manufacture and design of high speed engines, the result being that to-day no country in the world is producing high speed engines equal to those obtained here.

On the other hand, one wonders why, if foreign builders of Corliss and drop-valve engines can do such a large trade in engines for dynamo driving, our builders of Corliss engines should have done so little. Is it that they have lacked in enterprise, or have been too busy with other work, or is it that they foresaw the high speed engine and preferred not to invest their capital in the extensions which were necessary to enable them to take up additional Corliss engine work, the demand for which would not last? We have to-night amongst us many who are connected with

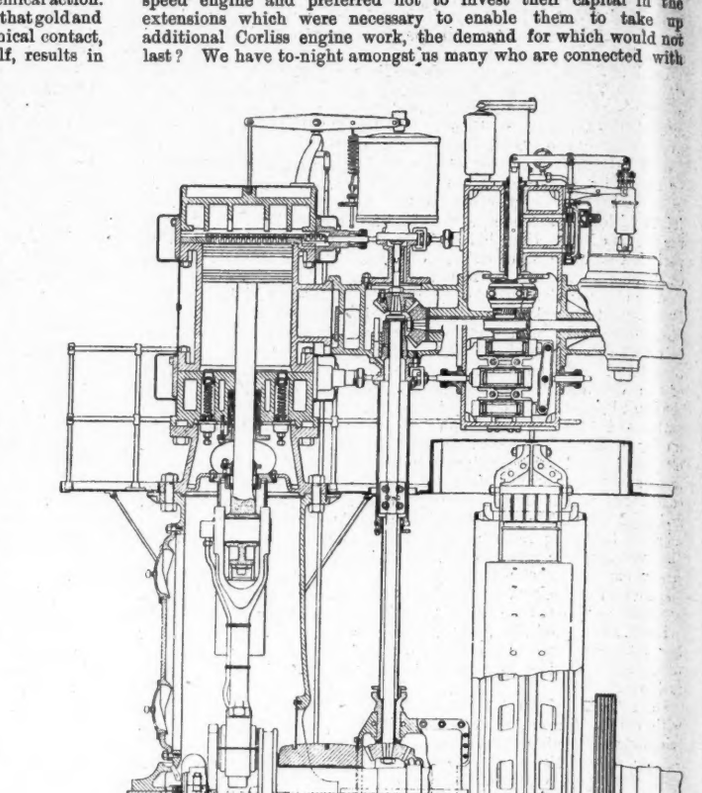


Fig. 1.

firms of slow speed engine builders, and I have ventured to make these remarks in the hope of hearing something on this score.

An interesting feature in the electrical trade is the steady increase in the size of plants. A few years ago a 500-H.P. engine and dynamo was considered large. To-day it is distinctly small, and about 30 electricity generating stations in Great Britain have engines of 1,000 H.P. and upwards.

Though England is behind America and the Continent in the number of these large units, we can, at any rate, claim to have been practically the first to point out the advantages of large units and high electrical pressures, as 15 to 16 years ago Mr. Ferranti urged the advantages of these, and in 1887 commenced the Deptford station. At this station several 1,500-H.P. engines made by Messrs. Hick, Hargreaves & Co., have been at work since 1888, and in addition to this, engines of 10,000 H.P. were designed and partially manufactured, also by Messrs. Hick, Hargreaves, the dynamos being made by Mr. Ferranti. Thus it will be seen that both English engine builders and English dynamo builders were quite early in the field on very large sizes. Unfortunately, the timidity of investors caused the abandonment of the 10,000 H.P. sets. A comparison which I have made recently of the drawings and specification of these engines, also of the drawings of the dynamos, with large sets now being made, show remarkably few differences, and there can be little doubt that had these sets been put to use they would have proved successful and would have been a great benefit to the engineers of this country.

Turning to the question of speed, the slower development in England of the use of electricity may to some extent explain the prevalence here of high speed engines, as both in America and on the Continent the size of unit has grown at a greater pace than has the size of high speed engines. Most of you are aware that it is within quite recent years that our English builders of high speed engines have reached sizes of 1,000 H.P.; builders of dynamos of large power have therefore been compelled to adopt slow speeds, and the methods of standardisation in America and Germany have helped to consolidate practice on to slow speeds.

On the other hand the question of speed is not only decided by the engine but is affected by considerations of dynamo design, at any rate as regards continuous current dynamos. The use of these latter in connection with tramways and railways, where load is very irregular, has shown that at high speeds of rotation the difficulty of keeping free from sparking at the commutator is greater than with

slower speeds. The difficulties of commutation have, however, been thoroughly surmounted up to speeds quite midway between those of slow speed trip gear engines and the prevailing speed of high speed engines; hence, the best policy in regard to engines of large size seems to be, to run at speeds higher than is permissible with trip gears though not high enough to introduce doubt as to sparkless commutation; with either single or multiphase alternating dynamos there are no commutation difficulties, and practically any speed can be adopted.

The advantages to be derived from increased speeds are:—

(*a*) Less floor space, and consequently less cost of land and buildings.
(*b*) Cheaper dynamos and cheaper engines.
(*c*) Better turning moments.

On the other hand, increase of speed introduces disadvantages such as—greater throwing about of oil, greater tendency to vibration, difficulty in securing automatic expansion, and necessity for more perfect lubrication.

The time at my disposal will not permit me to explain how these difficulties have been faced in Willans, Belliss, Browett-Lindley, and other high speed engines, hence I am compelled to confine myself to the engines made by Messrs. Ferranti, Ltd. I will therefore proceed with a description of one of these engines, and deal with the points just mentioned in their turn.

Type of Engine.

The type of engine adopted as a standard is the cross-compound vertical. The reason for our adoption of this type has been to secure a crankshaft having only two bearings, the dynamo being placed in between. By this means any trouble or increase of friction by imperfect alignment or by unequal wear of bearings, or by foundation settlement, is minimised. Another reason, though of less importance, is that in most electrical stations the load varies considerably, and to meet this we have thought a compound engine better than a triple. It is also to be remembered that the introduction of superheating will tend to take away any slight advantage in economy which a triple-expansion may have over a compound.

Another reason for the adoption of the cross-compound is that there are only two cylinders, and therefore the number of heavy working parts is reduced to almost a minimum.

The vertical type was adopted to minimise floor-space and cylinder wear. Where desirable, the engines can be modified to triple or quadruple expansion without interference with other features of the design.

Cleanliness.

For electrical work cleanliness is of the utmost importance, and the throwing about of oil or the creeping of oil along the crankshaft on to the armature must be prevented at all costs. This has been a difficulty to cure which considerable and very close attention to detail has been necessary, but these oil troubles have been entirely got over by thorough enclosing, and a suitable arrangement of oil throwers on the crankshaft.

Lubrication.

To ensure complete lubrication of all principal bearings, forced lubrication has been adopted. The advantages and disadvantages of this I briefly dealt with in a short communication to this Association last year. From fig. 1 you will note the arrangement of filter which has been adopted in connection with the forced lubrication system. This filter is arranged in the engine bed frame, and its object is to thoroughly cleanse the oil passing to the various bearings. By the arrangement adopted the oil is thoroughly filtered just before it is fed to the bearings. I have heard it suggested that this frequent filtration is likely to be detrimental to the oil and to cause it to lose its "body." We do not find this to be the case, and so far as I can see such a trouble only occurs when the "body" is an added one, and one which ought not to be there. The use over and over again of a quantity of oil will, however, if the engine is kept running for a long time, cause the oil to gradually get hot; thus, it is necessary for long runs to provide a water cooling arrangement, and this has been met by the introduction into the oil tank of a copper cooling pipe, also shown in fig. 1.

The method of lubricating the valve gear is, so far as I know, unique for valve gear, though extremely simple, and consists in surrounding the valve gear by a casing and filling this casing with oil. Thus the whole of the valve gear works immersed in oil, rendering the engine attendant's oil can quite superfluous.

Valves.

With a view to securing the economy of the slow-speed Corliss engine, cylinders, each having four valves, *i.e.*, steam and admission valve at each end, were adopted, but these instead of being Corliss valves are of the grid type, and are moved backwards and forwards; the gross movement of the H.P. valve during one revolution of a 1,000 H.P. engine is 1¼ in. At 214 r.p.m. this gives the low valve surface-speed of 22 ft. per minute, and I think you will agree with me that such a low surface-speed is an excellent quality as regards wear.

Another point to be noted with these valves is that they are placed in the covers so as to minimise clearance and give very short direct ports. The total volumetric clearance can be kept very low, though I hardly think it desirable for practical reasons to keep the clearance volumes extremely small.

An important feature in the valves is that they are perfectly free to follow the wear, and I can say positively that the running of the engine improves the valves and not otherwise, hence, after 12 months' running, the valves are tighter than when the engine commences work. Valve tightness undoubtedly has considerable influence on engine economy, and it will therefore interest you to have some reliable figures as to the economy of these engines.

At a test of a 500 H.P. engine at the Cardiff Electric Lighting Works the steam consumption per I.H.P. was 15·6 lbs., and per KW. 24 lbs. This was with a boiler pressure of 140 lbs., and a vacuum of 18·7 in The figure which we guaranteed was 26 lbs. per KW. with a vacuum of 27 in. On account of the deficient vacuum provided by the separate condensing plant, a calculated allowance was agreed upon, and this brought the steam consumption to 13·8 lbs. per H.P. per hour, and 21·8 lbs. per KW.

This test was made after the engine had been in fairly regular service for 18 months, and as the test was supervised by Mr. Michael Longridge, Mr. Burstall (of Messrs. Burstall & Monkhouse, consulting engineers), Mr. L. B. Atkinson, consulting engineer of Cardiff, and Mr. Mountain, electrical engineer to the Corporation of Huddersfield, the figures can I think be considered absolutely reliable. All instruments were properly checked and calibrated independently, the electrical instruments being checked by the Board of Trade.

(To be continued.)

THE ELECTRICAL WORKING OF RAILWAYS.

Paper on the "Working of Electric Railways on Main and Branch Lines," read before the Verein für die Förderung des Local und Strassenbahnwesens, in Vienna, by the President, Herr E. A. Ziffer.

In addition to the electric engines which are in use for shunting purposes at various railway stations, and the Heilmann locomotive, which has been making trial trips on the Paris-Lyons-Mediterranean Railway, I have to report at present on the actual running of electric motor trains, and subsequently of electric locomotives in the tunnel of the Baltimore and Ohio Railway, also on the Buffalo-Locksport line and the recent extension (35 miles in length) of the Albany and Hudson Railway in North America. Besides these I may mention the London Underground Electric Railway and the prolongation of the Orleans line as far as the Quai d'Orsay, in Paris.

Under these circumstances, considering how important the question of electric traction is both for the traffic on main and local lines, and also the strenuous efforts which are being made for its introduction, not only in America but also in European countries, in Germany, France, England, Italy, Switzerland, and even here in Austria and in Hungary, it is not surprising that at the International Railway Congress held in Paris in September of last year, the subject should have taken an important place amongst the various questions discussed.

I consider, therefore, that it lies well within the scope of our Society to investigate the subjects of these debates and the results arrived at.

The inquiries sent to various companies on the subject of electric traction were as follows:—(*a*) Experiments with electric traction on main line railways; (*b*) application of electric traction to local and branch lines.

The gentlemen who reported on these questions were for the United States, Mr. N. H. Heft, chief of electrical department, New York New Haven and Hartford Railway; and for the other countries, M. Anvert, chief engineer of the Paris-Lyons-Mediterranean Railway, and M. Mazen, Principal Inspector of French Western Main Lines.

I gather from the report of Mr. Heft that the New York New Haven and Hartford, the Pennsylvania Railroad, and the Baltimore and Ohio Railroad Companies, had already introduced electric traction on their railways as far back as May 20th, 1895, partly with the regular traffic, partly only as experiments.

The railways were induced to substitute electricity in the place of steam in the working of their trains on the main lines through the competition of the local lines, which caused in some places a reduction in the receipts to the extent of 80 per cent.

It appears from this report that Mr. Charles P. Clark, President of the New York New Haven and Hartford Railway, had already proposed to the shareholders to introduce electric traction on their line as far back as 1891, as this seemed to him the only means of averting the threatened competition; it is to him, therefore, that we owe the first introduction of the electrical system on the ordinary main-line railways. The network of New Haven differs from all other important railways in the United States, through the magnitude of its passenger traffic, and through the important proportions between the revenue derived from the aforementioned passenger traffic and the amount of the total receipts. It is also remarkable for the ratio of the passenger traffic to the local traffic, for the density of the population in the districts through which the line passes, and for the small area of this district in relation to the length of the network in actual miles.

During the business year ending June 30th, 1898, the company conveyed 61 million persons, and the revenue from passenger traffic exceeded £3,400,000, a sum representing 51 per cent. of the total receipts.

At about the same date the Pennsylvania Railroad authorised their President, Mr. George B. Roberts, to introduce electric traction on a branch line from Bordentown to Mt. Holly in the district of Amboy, and this change, also due to external competition, was completed in July, 1895.

In order to do away with the disadvantages of smoke and vapour which are unavoidable in connection with steam locomotion, the Baltimore and Ohio Railroad also completed the tunnel under the town of Baltimore in the year 1895, and besides that, introduced electric traction on the Circle and Underground Railways of that city.

It has been ascertained, by means of the reports of the above-mentioned railways confirming the success of their experiments in electric traction, that the motors at present in use on ordinary railway lines can carry light or heavy trains on the same rails, and with the same amount of traffic, as did the former steam locomotives. These motors are supported on bogies, which are fitted with one or two motors, as desired. In this way the passenger carriage becomes a locomotive, and its entire weight can be used for tractive effort; and, to add to its advantages, it offers the same amount of accommodation as any passenger carriage which would need to be drawn by a steam locomotive.

During those hours when the traffic on the line in question is small, a carriage with 70 seats can be used by itself, and when the demand for accommodation is great the requisite number of additional carriages can be attached to it. The trains running on these lines weigh 73 tons, and consist of one motor passenger carriage and two trailers, with an average speed of 30 miles per hour. Each of these trains contains 174 seats. A carriage with two motors on each bogie has an adhesive weight of 45·36 tons, and when occupied by 70 persons there is a gross weight of 50 tons available for adhesive force.

It is interesting to compare these figures with those of an ordinary passenger-train locomotive running in the suburbs of the same town. Here we have a gross weight of 75·3 tons, of which 32·6 tons are available for adhesive weight; there remain, then, 42·7 tons dead weight, which offers no seating accommodation.

The results arrived at by using electric traction on important railway lines demonstrate, therefore, that the experimental stage in the employment of electric motive power has been passed, and that wherever there is heavy and frequent traffic, or the requirements of agriculture and industry demand an efficient service, with the consequent increase of revenue derived from much passenger traffic, then electricity will rapidly replace steam as an effective means of transition.

The writer of this report goes on to enumerate the various causes, as far as they are known, which have been instrumental in inducing the tramway lines to substitute electricity for horse-power.

The development of these tramlines was marvellous; the first one of any importance was completed in 1889. At the end of the commercial year on June 30th, 1899, there were in existence no less than 1,031 different companies owning between them 16,000 miles of rails, 41,000 motor carriages, and 7,700 trailers. The capital of these companies amounts to £340,000,000 and their debentures to £140,000,000; in the same year, 1899, 3,140,000,000,000 people were conveyed by them, and the receipts from this passenger traffic covered the sum of £31,200,000.

Finally, the reporter draws attention to the fact that on those branch lines which traverse thickly populated districts the expenses are the least, whilst far greater costs are incurred in connection with railways through small towns or such as run parallel with ordinary railway lines on any part of their route.

Although till now managers of local railways have applied for concessions to construct electric lines which are destined to run side by side with steam railways and enter into active competition with the same; still the writer of this report thinks it will not be long before the owners of those companies which have till now adhered to steam traction will themselves apply for concessions which shall enable them to construct electric lines branching off from their own main railways and connecting the smaller towns and the various health resorts and such districts as are likely to provide sufficient goods traffic.

At the same time applications will probably be made for permission to construct electric railways in thickly populated centres, which shall have rails laid down throughout the country high roads and the main thoroughfares of the city in such a manner that they will eventually join on to the main railways, and thus effect direct through communication for passenger traffic between the different important cities of the realm. The trains would run through the public streets in the same manner as do the present trams, but between the various towns the rate of speed would be higher, and passengers would be conveyed from one town to another in the minimum of time and without the necessity of changing carriages.

The owners of the branch lines have legally acquired the right to force their way into the domain of the main steam railway lines, and have thus razed the barriers which till now separated their respective territories.

The large railway companies on their side now intend doing the same. The question remains whether they will carry out their designs as enemies who are sure of success, or as friends who make a compact for the purpose of mutual advantages. Time alone can give us the reply to this question.

The supplement of the report contains a very interesting summary of the replies sent in by the 20 different local lines existing in Connecticut, Massachusetts, Illinois, Virginia, California, New York, Ohio, New Jersey, Alabama, and Colorado, in answer to the 110 questions demanded in the interrogatory of the Congress.

The statement drawn up by M. Anvert in conjunction with Mr. Mazen on behalf of all the other nations, with the exception of the United States, demonstrates the progress and the increased use of electric traction, not only on local or special branch lines, but also on a large portion of the network of the more important railways. The innovation was due either simply to the desire for experiment or in order to secure permanent working. In most cases the reasons for trying this mode of traction were of special importance, either technically or industrially.

Too short a time has elapsed, in most cases, since the introduction of electric traction on railways for it to be possible as yet to give a definite opinion on the merits of the different systems in use.

Under these circumstances the writer of the report confines himself to enumerating the various systems that have been adopted by different railways, and then proceeds to describe in detail the arrangements for electric traction which have been made by them; those that employ exclusively alternating current, and those that have continuous current; also the methods for transmission of power for controlling and for generating alternating and continuous current, and, finally, the conducting rails.

In the supplement, reports are also included on the following railways:—

The electric line with three-phase current from Zermatt to the Gornergrat; a similar one running up the Jungfrau; one from Stansstadt to Engelberg, and another from Burgdorf to Thun; the electric City-Line in Buda-Pesth; the Waterloo and City Railway, the City and South London Railway; the Central London Railway; the electric lines from Düsseldorf to Crefeld and from Berlin to Zehlendorf; electric traction on the Italian railways; the electric locomotives of the Paris-Lyons-Mediterranean Railway; electrical experiments on the railway from Saint-Germain-West to Saint-Germain and Grande Ceinture; the metropolitan electric line in Paris; electric traction on the railway from Paris-Invalides to Versailles; light provisional motor trains from the Invalides to the Champ-de-Mars; electric equipment for trains running on the extension line of the Orléans Railway between the Gare d'Austerlitz and the Quai d'Orsay; electric locomotives for the working of the trains running between the Gare d'Austerlitz and the Gare Quai d'Orsay; electric railway from Faye to Chamounix and the Swiss frontier.

The above-mentioned railways, which are one and all worked by electricity, are described in every detail, and the report is further enhanced in value by the excellent illustrations, plans and drawings it contains. This portion of the report alone testifies to the extent of the studies made by its author, and is particularly instructive.

At the meetings held on September 25th last year by the 2nd and 5th sections of the International Railway Congress, the questions mentioned by me at the commencement of this paper were discussed in all their bearings. On this occasion M. Anvert gave an extract from the report which he had drawn up in conjunction with M. Mazen; at the same time making the remark that, according to his opinion, it was unnecessary to deliberate on all the points in the order in which they were mentioned in the interrogatory, concerning the use of electric traction on main and branch lines.

Whereas steam locomotives can be worked at very different rates of speed, up till now electric locomotives can only run with economy at a very limited speed. On the local lines a constant speed that never reaches a high rate for any particular train may suffice without special disadvantages, on the main lines, however, it would never do.

In the Sprague system all the carriages on each train are motor cars, which are all dependent on one driver, a plan which is of great advantage on mountain railways or on suburban lines.

Up to the present the greater number of installations employ the continuous current. The alternating current adapts itself best at high tension for traffic on long distances. The tension can be reduced by means of stationary transformers. This instantaneous and direct employment of alternating currents was first attempted in Italy, and has many advantages.

In one word, electric traction by means of the methods hitherto known is easily adopted to the use of branch lines; on the main lines, however, this is not the case as yet.

Subsequently, M. Mazen gives a summary of the report of Mr. Heft, from which he comes to the conclusion that up till now electric traction is only used on three of the main lines of railways in the United States. The other systems are more those of electric tramways of a medium or large order, the problem of which was solved some time ago. Mr. Heft is of opinion that electric traction will shortly be introduced on the big railway lines, but M. Mazen, on the contrary, shares the views of M. Anvert on the subject of the difficulties still to be contended with.

(To be concluded.)

OUR LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be as brief and concise as possible. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.*]

"Employer" writes: "In our fitting shop we have recently been compelled to institute a system of fines in order to protect ourselves against injury from neglect or carelessness on the part of our workmen. Thus the delay occasioned by the absence of a workman without leave not only causes one or two machines to be thrown out of work, but often renders a number of workmen idle, owing to failure in the supply of material upon which they are usually employed. Negligence on the part of workmen sometimes involves

the destruction of entire castings and heavy pieces of machinery which cost many hundreds of pounds to replace. I shall be glad to know whether (*a*) it is legal to inflict fines upon workmen for negligence and for wilfully absenting themselves from business; (*b*) fines so inflicted can be stopped out of the workman's wages. Would you please be so kind as to give references to any statutes or text-books which deal with the subject."

*** With regard to the first question addressed to us, we would refer our correspondent to the Truck Acts of 1831, 1887, and 1896. The first of these statutes was aimed at putting a stop to the payment of a workman's wages otherwise than in coin of the realm. It was then made unlawful for an employer to pay wages in goods or to pay wages by giving to his workmen an order giving credit at some particular shop. Any agreements designed to circumvent this statute were declared to be illegal and void. Nothing was said in it about fines, nor had it any effect upon an agreement, whereby the workman was to obtain *inter alia* medical attendance, fuel, and implements and tools for the purpose of earning his wage. The Truck Act of 1887, considerably extended the meaning of the term "workman" to which the Acts generally were to apply, and it provided further that in certain cases the fine for breach of the Act should not be inflicted on the employer, but on the actual offender. Neither of these Acts affected the question of fines for negligence or bad workmanship, which, if inflicted in accordance with agreement with the workman, or subject to the usages of trade, were perfectly legal down to 1896. In that year an important Act was passed which, while it did not declare that fines were illegal, regulated very strictly the terms upon which fines would be inflicted. That Act provides (*a*) that fines inflicted must either be specified in a notice put up where all can read it, or else form the subject matter of a written contract with the employer; and (*b*), that in all cases fines inflicted must be reasonable, the question of reasonability to be determined in a court of law. In determining this question it is clear that the fine need not necessarily bear proportion to the gravity of the offence or the loss occasioned to the employer. Thus for a workman to take a match into a powder works is a serious offence. If no accident occurs, the loss to the owner is *nil*; if an accident occurs which blows up the entire works, the loss is such as no workman could make good. In view of these principles we anticipate that the fines which our correspondent proposes to inflict would be upheld as reasonable in a court of law. It must always be remembered, however, that deductions on account of bad workmanship must always be restricted to the natural and probable damages thereby occasioned. Thus it is submitted that where a piece of work was spoiled through the negligence of a workman in the course of manufacture, his wages could not be attached for damages for breach of contract caused by delay in the delivery of the work as well as for the cost of new materials.

With regard to text-books there is none entirely devoted to the Truck Acts. Our correspondent will find the subject dealt with in Mr. Evans Austin's work on "The Factory and Workshop Acts," a new edition of which is, we believe, in the course of preparation.

MUNICIPAL AUDITORS AND DEPRECIATION.

THE course adopted by the auditor of the electric lighting accounts of the borough of Croydon is a healthy sign of the times, as he fearlessly exposes in his report upon the third year's trading the fallacy of the claim put forward of a surplus upon the working of £900.

The auditor's comments are so important that we must quote them fully:—"Nothing," he says, "has been charged against this department for the clerical and other work done at the Town Hall. A sum of £7,500 has been transferred from the debtor of the revenue account to the creditor of the general district rate account, £5,385 12s. 10d. being for interest, and £2,114 7s. 2d. as sinking fund. *I would point out that these are arbitrary amounts.* Further, I would bring before your notice that, while there is *no legal necessity* to charge against profits more than interest charges and sinking fund instalments, yet I think the burgesses should have brought before them most clearly that, in my opinion, *the depreciation is very much greater than the amount of the sinking fund;* and that if, instead of the electric lighting being a corporation department, it had been a company having the privilege of borrowing money at 3 per cent, the trading would, in my opinion, after writing off sufficient depreciation, show a heavy loss."

The amount of the sinking fund is £2,762, the capital expenditure at the end of the current year was £117,385, depreciation even calculated at the low rate of 3 per cent. on the amount standing to the debit of capital account each year would be £3,521, which would convert the £900 claimed as a surplus into *an actual loss, besides the amount required for the sinking fund.*

The auditor's complaint that nothing has been charged against the electricity accounts for clerical and other work done at the Town Hall applies to a common practice. It will be remembered that in our criticism of the Tunbridge Wells accounts (see ELECTRICAL REVIEW, March 29th, 1901), we referred to the fact of the auditor having charged, *for the first time* in the accounts for the year ending March 31st, 1900, "a fair proportion of the general salaries and establishment charges," amounting to £250, and in the reports for the year 1901, being the fifth completed year, the chairman of the Committee complains of this charge, which has been increased to £308, being "out of all proportion to the services which the undertaking receives in return," but no back payments are thought of to cover the three years when nothing at all was charged.

We mention this as another illustration of the practice complained of by the auditor of the Croydon Corporation; but more important still is his opinion that "the depreciation is very much greater than the amount of the sinking fund," and he thus confirms what we have so persistently claimed in dealing with municipal electrical undertakings.

But we welcome another convert to our views in the *Municipal Journal* electrical expert, who points out in the issue for the 18th ult., in commenting upon Lord Rosebery's recent speech at Stranraer, that "Probably the most serious aspect of the question is the means whereby depreciation allowances are allowed, and the amounts set apart yearly for this purpose. In all directions doubts are being expressed as to sufficiency of these allowances in the matter of municipal electric lighting works"

In *Traction and Transmission* for August last, the editor of the *Municipal Journal* asserted that "Municipalities, on an average, supply electricity 1d. per unit cheaper than companies." In our remarks upon this statement (ELECTRICAL REVIEW, September 20th), we said: "May it not be a fact that if it were so, local authorities have been charging too little, and that men who understand their business have adopted the proper tariff?"

This view is now endorsed by the *Municipal Journal*, with especial reference to the unfavourable accounts just issued by the Corporation of Tunbridge Wells. Our contemporary wisely says: "Inasmuch as only a portion of the ratepaying population of a town use electric light, it is obviously unfair to the greater interests to charge an unremunerative rate to the lesser for a service which has incurred an outlay higher in proportion than was previously the case."

Many local authorities have already raised the prices for electricity, while the companies adhere to their rates, which compare favourably, as a rule, with those of Corporations.

The accounts for last year of the majority of the undertakings by local authorities are less favourable than in the preceding year, but the ratepayers are consoled for the increased losses by putting the blame on the cost of coals, and making the figures as palatable as possible by adopting the methods so ruthlessly exposed by the auditor of the Croydon Corporation; but the excuses put forward to console the ratepayers of Tunbridge Wells are perhaps the most ingenious we have met with. In presenting former accounts, the borough accountant made a report, but in those for the last year he signs them only, the chairman of the Committee and the electrical engineer each making reports instead upon the character of the accounts.

To the chairman the public are indebted for some useful information as to the practice of local authorities in making no charge in their electric lighting accounts for office accommodation and the services of the town clerk, instancing such places as Belfast, Bolton, Bradford, Hanley, Lancaster, Manchester, Newport, Oldham, Portsmouth (besides a comprehensive "number of others") as making *no charge* whatever under this head, while at Nottingham and St. Helens only a nominal £50 is charged.

The accounts show a deficit of £482 1s. 10d., but if depreciation were provided for, even at the rate mentioned by the engineer in his letter to us of March 6th last, viz, 2·83 per cent. on the total capital, this loss would be increased to £2,067; but Mr. Boot shows how a profit of £1,636 would have been made if something had not happened which, unfortunately, upset all his calculations. This is a novel consolation for the unfortunate ratepayers; it was certainly very aggravating to have to re-tube those boilers, but this could not be helped; but why charge *under cost price* for the public lighting? Surely that is not sound trading, municipal or otherwise. We cannot reconcile the engineer's statement of accounts with those of the borough accountant. In the former the income from the public lamps is £822 14s. 11d., and in the latter £1,518 5s. 6d. Private lighting, according to the engineer, produced £7,702 13s. 1d.; but the accountant credits £7,592 13s. 1d. No doubt these differences can be explained, as both agree in finding the deficit to be £482 1s. 10d.; but the statement is somewhat puzzling.

Mr. Boot calculates that the average price paid by private consumers is 4·46d. per unit, the current metered being 374,220 units, and the amount received being as stated above. It would appear that if the correct figures for the receipts are as stated by the accountant, the average price obtained was 4·96d., and if the engineer's figures are taken it is 4·86d. The total current generated was 702,574 units, of which 128,660 were used in distribution, or 18·31 per cent.

It is to be regretted that local authorities are not obliged to render their accounts in the form prescribed by the Board of Trade for companies, and to have them audited under similar arrangements; as it is there is no uniformity of practice, and facilities exist for making the accounts look more favourable than the facts justify. The *Daily Mail* recently pointed this out in a leading article in these words: "All municipal authorities are anxious to show that their investments are lucrative, and where there is actually no profit, but a loss, that loss can be hidden by a little dexterous juggling. Renewal of machinery, and scrapping of old plant can be overlooked for a few years. But the real meaning of such finance should not be missed. It sacrifices the future for the present, and threatens the welfare of posterity. The 'higher accountancy,' as it is understood in America, should be invoked by the central Government, and applied to the local accounts, so that we may know how we really do stand."

We will meet the alleged claim for municipal success in electricity supply with a few figures, which we commend to the careful consideration of our readers:—

At the end of the 17th year of the introduction of electricity into Liverpool and the 5th year of its being a municipal undertaking,

the capital expenditure was £1,048,558, and the alleged surplus £5,497, equal to ·52 per cent. The amount of the sinking fund £17,833, or 1·7 per cent.; number of units sold being 11,564,335.

At Manchester, at the end of the 6th year of trading, the Corporation had spent £641,822, and claim a surplus of £9,765, equal to 1·52 per cent.; sinking fund £12,935, or 2 per cent.; units sold 6,355,872.

At Edinburgh, at the end of the 5th year, the capital expenditure was £595,655, alleged surplus £3,674, or ·61 per cent.; sinking fund £14,119, or 2·37 per cent.; units sold 5,551,728.

At Leeds, at the end of the 6th year, capital expenditure £307,522, alleged surplus £8,502, or 2·76 per cent.; sinking fund £17,789 or 5·78 per cent.; units sold 2,005,840.

At Glasgow, 9th year of working, capital expenditure £836,146, and a deficit on the municipal trading of £4,517 6s. 11d., and nothing carried off for depreciation.

These are the results in our great cities—sceptics in the virtues of accountancy think that figures can be made to prove anything—but it would be difficult indeed to make them convert the official electric lighting accounts of local authorities into evidence of municipal trading in electricity being a commercially profitable undertaking.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1901.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

20,491. "Improvements in and appertaining to starting devices for electromotors." G. N. Thomas. October 14th.

20,497. "Improvements in cable terminal boxes for electricity supply purposes." G. Wilkinson. October 14th.

20,515. "A leather or other material insulator cap or hand protector for electric car brake handles or other handles." E. Nock. October 14th.

20,561. "An improved feeder or junction box for electric mains." H. McGillivray and G. Carr. October 14th.

20,596. "Improvements in wireless electric signalling appliances." W. M. Walters. October 15th.

20,602. "A device for safety gripping and securely holding an electrical conductor while at dangerously high potential." G. Thompson and P. S. Thompson. October 15th.

20,609. "Improvements in arc lamps." J. Tourtel. October 15th.

20,612. "Improved electric switch and circuit breaker." Veritys, Limited, and E. J. Selby. October 15th.

20,619. "Improvements in electric telegraphy." A. R. Upward and A. M. R. C. LeMesurier. October 15th.

20,628. "An insulating coating replacing india-rubber and gutta-percha, and intended to insulate the wires having the property of conducting electricity." E. L. J. S. de la Grange. October 15th. (Complete.)

20,351. "Improvements relating to electric arc lamps." H. O. Schmidt. October 15th. (Complete.)

20,792. "Improvements in the renewal and repair of incandescent electric lamps." T. A. Rose. October 16th.

20,732. "Improvements in means for regulating electric currents, applicable to the lighting, heating and ventilating of railway trains and other structures." E. M. Preston of the firm of J. Stone & Co. October 16th.

20,752. "A new or improved means of adjusting the height of suspend articles, such as electric lamps and the like." H. Wilkinson. October 17th.

20,788. "Improved apparatus for trueing up commutators of dynamos." B. M. Drake and J. M. Gorham. October 17th.

20,818. "Improvements in and relating to means for the avoidance of hunting of synchronous alternate current machinery running in parallel." H. C. Leake. October 17th.

20,815. "Improvements in electrical storage cells or accumulators." R. B. Sangster. October 18th.

20,852. "Improvements in the method of producing fabrics or aprons for conveying rubber or the like to be used in the manufacture of electric cables, or for other purposes." F. Reddaway. October 18th.

20,931. Improvements relating to electric telegraphy." D. Murray. October 18th.

20,945. "Improvements in means to be employed in the electro-deposition of metals." The Cowper-Coles Galvanizing Syndicate, Limited, and S. Cowper-Coles. October 19th.

20,959. "Automatic electric point shifter." W. G. Primrose. October 19th.

20,937. "Improvements in the manufacture of electric incandescent lamps." T. W. Lowden. October 19th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester and Birmingham, price, post free, 9d. (in stamps).

1899.

25,741. "Improvements in and relating to lightning arresters." A. J. Wurts. Dated December 30th, 1899. Lightning arresters of the kind described in the United States Specifications Nos. 509,783 and 509,784, A.D. 1893, are arranged with a common spark block attached to divided spark blocks by strips of wood having the grain perpendicular to the block; charred grooves are formed between the blocks. The blocks carry sockets for resistance rods, the other ends of which fit in sockets attached to an earth plate. The resistances are formed of a dried mixture of graphite, kaolin, and an adhesive such as starch. 5 claims.

25,744. "Improvement in dynamo-electric machines." British Thomson-Houston Company. (H. G. Reist.) Dated December 30th, 1899. Relates more particularly to machines having terminals for both direct and alternating currents, rotary converters, and double current generators, but some of the improvements are applicable to direct current machines. 10 claims.

25,745. "Improved method of regulating dynamo-electric machines." British Thomson-Houston Company. (C. P. Steinmetz.) Dated December 30th, 1899. Relates to systems of regulation in which the field excitation varies with the load. 18 claims.

25,747. "Improvements in safety devices for dynamo-electric machines." British Thomson-Houston Company. (H. W. Buck.) Dated December 30th, 1899. Relates to means for preventing the over-running of dynamo-electric machines, especially rotary converters, and consists in a cut-out device depending upon the frequency of the alternating current. 8 claims.

25,748. "Improvements in electric railway systems, worked with alternating currents." British Thomson-Houston Company. (A. H. Armstrong.) Dated December 30th, 1899. In third-rail or like electric railway systems worked with alternating single or polyphase currents, the working conductors on the line are connected at numerous points to non-magnetic or non-inductive conductors supplied with current from the secondaries of the transformers, of which the primaries are excited from the generating station. The number of transformers and the effect on the motors and the current of the self-induction in iron or steel working conductors may thus be reduced. 10 claims.

25,749. "Improvements in systems of electric train control." British Thomson-Houston Company. (W. B. Potter.) Dated December 30th, 1899. Relates to a system of electric train control in which all the motors can be put in or out of action from one point. 11 claims.

25,750. "Improvements in controlling electric motors." British Thomson-Houston Company. (M. W. Day.) Dated December 30th, 1899. Relates to systems of motor control, the object being to permit motors of standard construction to be operated at variable speed. 4 claims.

25,751. "Improvements in electric time switches." British Thomson-Houston Company. (C. H. van Slyck.) Dated December 30th, 1899. A time switch is arranged so that a chronometer at predetermined times closes a shunt circuit through a magnet coil which operates mechanism for opening or closing a switch. 20 claims.

25,752. "Improvements in electric meters." British Thomson-Houston Company. Dated December 30th, 1899. Energy and quantity meters of any kind having registering dials, are provided with means for separately registering current flowing in different directions, and especially the charging and outflowing currents of storage batteries. 10 claims.

25,767. "Improvements in or relating to electric motors." H. Rowntree. Dated December 30th, 1899. Relates to continuous current motors for operating lifts, &c., and to the means for varying the speed and direction of operation thereof. A motor is employed in which the armature and field are independently revoluble and one of the parts is rotated by an auxiliary motor, which may be an electric, steam, gas or other motor. The speed and direction of rotation of the main motor are controlled by varying the strength of the current supplied either to its field or armature. 47 claims

25,768. "Improvements in and relating to electric lifts." H. Rowntree. Dated December 30th, 1899. In electrically actuated and controlled lifts the following objects are effected, viz., (1) All the movements of the cage are controlled by push buttons in the cage and at the landings; (2) By the operation of a push button at a landing, or a corresponding one in the cage, the movement of the cage to, and automatic stoppage at, that landing is effected; (3) The hoisting mechanism cannot be put into action until all the well doors are closed; (4) A push button having been operated, any subsequent operation of another button is effective until the cycle of operations proper to the first button has been completed. (5) The motion of the cage is automatically accelerated and retarded as it is started and stopped respectively. The necessary electric circuits are shown diagrammatically in the specification. Each push button at a landing and the corresponding button in the cage controls a circuit which includes a magnetic switch. Each of these switches controls a circuit including one or other of two solenoids. Each solenoid circuit includes a contact making arrangement adapted to be broken automatically when the cage has reached the landing corresponding to the button manipulated, and also adapted to effect automatically a slowing down of the motor as the cage approaches the landing at which it is to stop. Each solenoid actuates sets of switches through which the motor circuits are controlled. 59 claims.

1900.

27. "Improvements in electric arc lamps." H. Lyon and J. B. Talbot-Crosbie. Dated January 1st, 1900. Relates to arc lamps with enclosed arcs.

45. "Improvements relating to electrical incandescence lamps of the Nernst type." V. I. Feony. (Allgemeine Elektricitats Gesellschaft, Germany.) Dated January 1st, 1900. A lamp is made with two filaments or rods of equal lighting power, one being of carbon, silicon, a mixture of these, or other material which conducts and becomes incandescent immediately when current is supplied, and placed so as to heat the second filament, which is of material conducting only after preliminary heating; when the second filament has become incandescent, the supply of current to the first one is stopped by automatic apparatus. The invention is a modification of that described in Specification No. 23,470. A.D. 1897.

81. "An electrically operated clip to be employed in machines for tentering and stretching fabrics." W. Whitely and W. Whitely. Dated January 2nd, 1900. Stretching and tentering. In tentering fabrics while being dried or otherwise treated, the clips are electrically actuated, and thus can be made light and sensitive. The provisional specification states that the lower nipping jaws may be electrically heated, so that the selvages may be dried simultaneously with the rest of the fabric.

138. "Improved method of telegraphing, indicating time, or actuating mechanism electrically." C. R. Loubery. Dated January 2nd, 1900. Relates to arrangements by which the circuits of a system of electric supply are employed for signalling telegraphically to any of the subscribers' stations, controlling electric clocks, or controlling the supply of electric energy for lighting, power, or street lighting purposes.

146. "Improvements in starting or controlling apparatus for electric motors." J. H. McGurty and T. McEwen. Dated January 2nd, 1900. Relates to means for starting and controlling electric motors.

147. "Improvements in electric water filters." W. L. Toter and J. A. Heany. Dated January 2nd, 1900. Electrolytic filters. The inlet chamber is separated from the filter chamber by a disc of porcelain or the like supporting a tube of similar material, fitted with electrodes and having two long legs passing through the disc and an outlet opening below the inlet chamber.

163. "Improved automatic make and break for electric circuits." P. C. McFarlane and D. Reid. Dated January 3rd, 1900. A periodic make and break is obtained by fitting a contact-spring on one of the arms of an escapement. The spring is insulated from the arm, though connected to a terminal by a spring and makes contact at intervals with pins carried by the escapement-wheel.

176. "A current receiver for electric railways." F. Lachemmeyer. Dated January 3rd, 1900. Electric railways and tramways with overhead conductors. Collectors.—To prevent the trolley from leaving the conductor, a four-armed star wheel is mounted on each side of the collecting wheel. The star wheels are keyed on the axle, and are counterweighted or held by a ratchet wheel and spring pawl, so that one pair of arms are always returned to an effective position.

182. "Improvements in electric devices for internal combustion engines." P. W. Northey and the Electric Motive Power Company. Dated January 3rd, 1900. Igniting.—To prevent short circuiting owing to a deposit of carbon around the guiding points, particularly in engines using heavy oils, the sparking terminals comprise a platinum disc and an insulated wire at the mouth of a cavity in the plug. The insulating material may be in a simple cylinder, or it may extend into the lining of the plug.

240. "Improvements in or relating to magnetic brakes and magnets suitable therefor." T. von Zweigebork. Dated January 4th, 1900. Relates to magnetic brakes, and to electro-magnets therefor, shown in conjunction with the axle of a railway car having a motor mounted thereon.